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AN INTERREGIONAL ANALYSIS OF THE FED BEEF ECONOMY

U.S. DEPARTMENT OF AGRICULTURE ECONOMIC RESEARCH SERVICE
OKLAHOMA AND TEXAS AGRICULTURAL EXPERIMENT STATIONS

CONTENTS

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HIGHLIGHTS

The evolution of the Nation's fed beef industry since World War II has directed increased attention to problems associated with interregional adjustment. In this study of changing interregional economic relationships, the fed beef economy was conceived as a closely interrelated system of markets and supply areas. The analysis was confined within a carefully designed set of restrictive assumptions regarding underlying economic circumstances. These assumptions were systematically altered so that effects of specified situations or variables could be measured.

The study confirms the widely accepted hypothesis that location and transportation costs are important determinants of competitive market power in interregional fed beef commerce.

Regions producing surpluses of fed beef are principally the North Central region including the Northern Plains, and the Kansas-Missouri area, as well as the Central Corn Belt and other areas such as Colorado and Arizona. The Southern Plains States of Oklahoma and Texas also are rapidly emerging as surplus regions. The major deficit regions are the Northeast, the East South Central and Southeastern regions, and California.

Spatial equilibrium findings of the study suggest with respect to fed beef that:

1. The Central Corn Belt and the Northern Plains regions enjoy locational advantages over other regions in the Northeast.

2. Location provides the Southern Plains with competitive advantages over other surplus regions in most major markets of the East South Central and Southeastern regions.

3. Under present conditions, the Kansas-Missouri area, as well as the Southern Plains, is located disadvantageously with respect to live or dressed shipments to California.

4. Located far from all deficit markets, Colorado, nevertheless, would be able to ship East, West, or Southeast; however, relatively lower prices would prevail in Colorado and other northern Intermountain States.

5. With emergence of the Southern Plains as an important surplus producer of fed beef, most other surplus producing regions would be affected; Colorado and other northern Intermountain regions would probably be affected most severely.

6. Locational factors suggest a continued relative shift of fed beef slaughtering facilities from the Northeast and other deficit areas to the Central Corn Belt, the Northern and Southern Plains regions, and other surplus regions; they also indicate that these shifts would be associated with net reductions in the total of interregional transportation costs on fed beef.

Although the findings demonstrate the importance of location as a factor in interregional competition, they also suggest that fed beef location relative

to markets is not a matter of overriding concern. Price differentials among surplus regions and transportation cost differences among these regions to deficit markets frequently are so small that they are readily offset by other factors. Location relative to feed and feeder cattle as reflected in delivered costs may be more important. Regional differences in competitive position and market power are affected, in addition, by regional differences in (1) characteristics of demand, (2) development and adoption of new technological and organizational techniques, (3) size or scale of feedlots and meatpacking facilities, (4) wage rates and prices of other inputs employed in feeding, handling, or packing, (5) taxes, insurance costs, and depreciation rates, (6) management, and (7) weather. These and other factors will determine the future location of production and marketing facilities in the fed beef industry.

AN INTERREGIONAL ANALYSIS OF THE FED BEEF ECONOMY 1/

by

Willard F. Williams and Raymond A. Dietrich 2/

INTRODUCTION

Development and continuing transition in response to the stimulus and challenge of a changing economic environment characterize the fed beef sector of the national beef economy. A rapidly increasing consumer demand after World War II, among other factors, presented the fed beef industry with new opportunities for growth. Additional opportunities were provided by improved techniques of production, slaughter, and processing, and innovations in merchandising and distribution. But opportunities and potentials are not realized without problems. Adjustments are costly and they generate additional series of adjustments beyond those required to accommodate the initial developments.

Intelligent decision-making is the key to meeting the challenge of changing conditions in the fed beef industry and other sectors of American agriculture. Intelligent decisions require knowledge derived through research and experience. With improved knowledge, decision-makers may avoid some of the costs and risks associated with adjustments and may realize potentials more quickly and effectively. These lead, in turn, to higher levels of efficiency, more orderly systems of distribution, and more accurate and equitable pricing arrangements. This study was conducted within a limited framework and involves a specified portion of the beef industry. It is a pioneering inquiry into questions regarding sources and effects of changes in interregional competition in fed beef. Emphasis is placed on implied requirements and opportunities for industry adjustments.

THE PROBLEM

The livestock and meat industry was subjected to an intensified envolutionary process after World War II.

Among the changes were many that have significantly affected the nature and location of livestock production, location of livestock slaughtering and processing, trade patterns, and the character of interregional competition. These included the following:

1. Differential rates of growth among regions in population and per capita income which altered the regional distribution of meat consumption and changed the level and character of demand.

1/ Based primarily on Dietrich, Raymond A., An Interregional Analysis of the Fed Beef Economy, unpublished Ph. D. dissertation, Okla. State Univ., Aug. 1964.

2/ Mr. Williams is Head, Department of Agricultural Economics, Texas Technological College and former professor, Dept. Agr. Econ., Oklahoma State University. Mr. Dietrich is Agricultural Economist, Marketing Economics Division, Economic Research Service, U.S. Department of Agriculture.

2. Revolutionary changes in the structure of the retail food economy along with changes in procurement practices of retailers; regional differences in both structure and practices led to more pressure for adjustments in some areas than in others.

3. Structural reorganization, decentralization, and increased specialization of the livestock marketing and meatpacking, processing, and distribution systems. 3/

4. Technological innovations outside as well as within the livestock-meat industry and regional differences in acceptance, adjustments to, and effects of these innovations. 4/

(a) Development of new feeds or feed additives and supplements, feeding methods, and management techniques for use in livestock production.

(b) Improvements in transportation, in-transit refrigeration, and communication.

(c) On-the-rail systems of slaughter and numerous other innovations in meatpacking and processing plants.

(d) Regional differences in timing or rates of adjustment to emerging facts of business life. 5/ Some types of producers, plants, or areas were better adapted, equipped, or located to adjust to new methods and practices.

5. Regional differences in supplies or in prices of necessary resources and factors of production, and changes in these differences. 6/

6. The increased availability and use of marketing information, Federal grades and standards, and detailed product specifications which encourage direct marketing, purchases by description, and specialization.

3/ These are adequately described elsewhere. See Williams, Willard F., and Stout, Thomas T., Economics of the Livestock-Meat Industry, The Macmillan Co., New York, 1964, Chapters 7-17.

4/ Through improvements in transportation and communication all regions of the Nation were brought into more intimate economic competition with one another. Nevertheless, the number and variety of technological innovations, within the meat sector of the industry, along with regional differences in rates of adoption are striking and significant.

5/ Partly as a result, of course, of regional differences in factor prices, structure, demand, and other forces mentioned earlier.

6/ Examples are the changing availability in the South of lower cost labor, the rising cost of labor and land in or near the larger metropolitan centers, the close but changing relationship in the Corn Belt between corn production and livestock feeding, and the simultaneous expansion of feed grain production and cattle feeding in the Southwest.

All of these and other forces contributed to marked changes in economic relationships among regions and directed attention to problems associated with interregional adjustments. Effects of these forces were expressed in the appearance and growth of a cattle feeding industry in the West; the sharp decline of hog production in many areas, including the Southwest; the appearance of a cow-calf industry in the South; general retreat and regional shifts by the sheep industry; the accelerated transfer of the meatpacking sector out of the Northeast and metropolitan centers to principal areas of production; the appearance of specialized, low-cost, shipper-packers in Colorado and Western Corn Belt areas; and the improved competitive situation of the Corn Belt relative to most other regions in hog production.

It was in this setting that the fed cattle sector developed to its present position of prominence in the industry and began to suffer growing pains. During 1947-64 numbers of cattle on feed (January 1) in the United States rose from about 4.3 million to 9.1 million (table 1). Annual feedlot marketings increased even more--from an estimated 6.3 million head in 1947 to 15 million in 1963. By 1962, fed beef slaughter accounted for about 61 percent of the total commercial beef slaughter and for nearly 70 percent of the commercial steer-heifer slaughter.

Although the Central Corn Belt region still is the principal area of fed cattle production in this country, other regions are responsible for most of the growth since 1947 (table 1). Following World War II, numbers of large feedlots and feedlot production expanded rapidly in California and Colorado. A rapidly growing West Coast population with rising per capita incomes and a taste for beef, among other factors, encouraged the spread of the commercial feedlot movement to Arizona and throughout the Intermountain West.

Meanwhile, fed cattle production was beginning to grow more rapidly in the Lake States, the Northern Plains, and the Central Corn Belt. The Northern Plains increased its production relative to other areas of the North Central region. Cattle feeding became heavily concentrated in Nebraska as well as in Iowa. While the Central Corn Belt maintained its relative share of fed cattle inventories in the North Central region, there was a westward shift in production within this central territory.

In the Southern Plains and Kansas, fed cattle production expanded slowly until about 1958. Drought conditions, distance from markets, and other factors retarded the industry in this area. But with continued increases in the national demand for fed beef, and sharply rising production of feed grain, principally milo, in Kansas, Oklahoma, and Texas, numbers of feedlots and feedlot production began to rise rapidly throughout this territory. It is significant in this context that the national increase in demand included an increase in the demand for fed beef in Texas and elsewhere in the South. The Southern Plains made the largest percentage gain in fed cattle production during 1958-64, with most of the increases appearing in Texas. More recently, inventories of cattle on feed have been rising in Georgia, Alabama, and other States of the Southeast (table 1). The present significance of these trends and considerations is manifested in uncertainty regarding the nature and effects of continuing pressures for interregional adjustments.

Table 1.--Numbers of cattle and calves on feed, January 1, and percentage changes for selected periods, by selected States and regions, United States, 1947-64

Year	North-east	North Central				Intermountain West						Total 26 States	11 other States	Total 37 States
		Central: Corn Belt	Lake States	North-ern Plains	Kansas and Missouri	South-ern Plains	Colorado	Arizona and New Mexico	Other	Cali-for-nia	Pacific North-west			
	Thousand head													
1947	90	1,773	440	647	557	171	146	61	197	166	59	4,307	---	---
1948	85	1,460	400	544	440	165	180	87	203	209	48	3,821	---	---
1949	88	1,677	463	685	580	214	192	95	222	258	56	4,530	---	---
1950	88	1,754	471	657	494	216	206	76	180	196	52	4,390	---	---
1951	90	1,745	477	684	482	239	229	103	187	248	50	4,534	---	---
1952	90	1,817	495	776	472	241	300	125	211	383	51	4,961	---	---
1953	90	2,242	527	1,030	523	271	296	134	261	327	61	5,762	---	---
1954	86	2,137	536	891	439	205	245	138	278	350	65	5,370	---	---
1955	84	2,248	526	933	457	200	275	200	301	482	89	5,795	---	---
1956	82	2,290	552	883	442	214	284	248	324	503	107	5,929	---	---
1957	90	2,409	593	908	413	218	298	264	306	509	114	6,122	---	---
1958	78	2,364	580	907	436	163	298	223	305	504	139	5,898	---	---
1959	77	2,509	623	1,020	480	234	355	262	355	511	175	6,601	---	---
1960	83	2,596	670	1,037	545	317	404	319	356	665	181	7,173	362	7,335
1961	89	2,673	725	1,168	634	328	414	346	377	716	175	7,645	362	8,007
1962	89	2,691	699	1,294	602	409	397	374	337	782	191	7,865	418	8,283
1963	80	2,928	783	1,337	660	537	525	463	365	1,000	209	8,887	1/397	2/9,284
1964	80	2,907	781	1,287	648	593	510	418	376	946	212	8,758	1/383	2/9,141
	Percent													
Percentage distribution:														
1947	2.1	41.2	10.2	15.0	12.9	3.9	3.4	1.4	4.6	3.9	1.4	100.0	---	---
1964	0.9	33.2	8.9	14.7	7.4	6.8	5.8	4.8	4.3	10.8	2.4	100.0	---	---
Percentage change:														
1947-64	-11.1	64.0	77.5	98.9	16.3	246.8	249.3	585.2	90.9	469.9	259.3	103.3	---	---
1958-64	2.6	23.0	34.7	41.9	48.6	263.8	71.1	87.4	23.3	87.7	52.5	48.5	---	---

1/ 10 States.
2/ 36 States.

Numerous questions regarding location and the nature of interregional competition arise and these often differ depending upon the length of run under consideration. In the short run, the questions are confined primarily to problems concerning (1) the selection of feeder supply sources, types of feeders, rations, feeding techniques, and length of feeding periods that will minimize costs, and (2) the choice of markets, modes of transportation, and merchandising methods that will maximize f.o.b. returns. In a competitive environment, competitively low prices, quality control, and service become essential short-run, as well as long-run, considerations.

Questions for intermediate and long-run horizons are more numerous and are infinitely more complex. The long-run problem is to determine (1) where the livestock will be produced and the sizes and types of enterprises necessary for most profitable production, (2) where the slaughtering and processing will take place and what numbers, sizes, and types of plants will be needed for maximum efficiency, and (3) where, in what form, and what prices the final product will be consumed. Within this range of general questions, the problem facing the firms in any individual region is to determine the nature and types of adjustments that will tend to maintain and maximize competitive advantages and potentials. In the long run, competitively low prices may not be sufficient to ensure interregional superiority. While such prices are essential, a region cannot expect to compete indefinitely with another simply by accepting lower f.o.b. prices, unless these are justified by lower costs. Persistently lower net incomes in any region will tend to discourage industry growth and may induce the industry to move to areas offering more attractive income possibilities. The key to the future of an industry in any region, therefore, lies in adjustments that will permit the simultaneous attainment of two events: (1) Competitive prices and (2) attractive net returns.

Factors affecting interregional trade and competition are numerous and, therefore, not all can be considered and handled simultaneously. For this reason, while the fed beef economy is conceived in this report as a closely interrelated system of markets and supply areas, it is confined within a carefully designed set of restrictive assumptions regarding underlying economic circumstances. These assumptions are systematically altered or varied in such a way that effects of specified situations or variables can be measured. Each set of assumptions provides a different model of the fed beef economy.

Findings of the study are intended neither as descriptions of the real world nor as predictions. Instead, the models were designed to provide controlled insight into decision-making criteria associated with the following questions:

1. Given a simplified approximation of economic conditions in the fed beef industry during a recent year and assuming an intensely competitive situation, what is the nature of the interregional economic relationships in marketing fed beef? What economic advantages and disadvantages do the various regions have in competing for markets or for supplies?

2. What types of changes in interregional economic relationships, affecting distribution patterns, access to markets, prices, etc., likely would be associated with a continued shift of the fed beef packing industry toward principal areas of production?

3. What changes in economic relationships are implied by specified interregional shifts in fed beef production? Specifically, what effects might be associated with continued relative increases for the Southern Plains and other areas of the South in fed beef production on competitive situations and locational advantages of these and all other regions?

4. What is the contribution of regional differences in slaughtering costs, as indicated by regional differences in average plant size and in wage rates, to regional differences in competitive situations and potentials?

Answers to these questions require simultaneous considerations of all regions. Electronic computer techniques, therefore, were used. 7/

Regions selected for study are shown in figure 1. Region 13, consisting of Nebraska and the Dakotas, was selected as the base region because of its central location and large surplus production. A single shipping or receiving point was chosen for each region, as indicated. These points were as near the center of the regions as possible, and generally, but not always, were important marketing points. Live or dressed supplies of fed beef, as required, were determined for each region, as were demand conditions and initial estimates of consumption. The truck and rail transportation costs between each possible pair of regions also were computed. The livestock or meat was shipped by truck or rail, whichever was cheaper, and since fed beef was assumed to be a homogeneous commodity, each region was expected to supply its own needs first and to export or import the remainder to or from other regions. Regional differences in costs of fed beef production, including opportunity costs, were not considered.

Given the available data on fed beef supply, transportation costs, and demand conditions, spatial models were used to (1) determine the final estimates of consumption for each region, (2) distribute available excess supplies to deficit markets optimally, i.e., by shortest and least costly routes so that all consumption requirements were met and the total national transportation cost was minimized, and (3) determine equilibrium prices, i.e., prices for each region consistent with existing supply-demand conditions and the optimum allocation of surplus quantities.

Findings revealed preferred markets for each surplus region and least costly sources for each deficit area. They also suggested the price or cost conditions necessary for entry into new market areas or supply sources, thus indicating competitive relations among regions. As suggested earlier, basic conditions were altered systematically and new solutions were obtained to determine effects of specified conditions or variables.

7/ The Perry and Bonner 650 Linear Programming technique and spatial equilibrium models were employed. A linear programming model was used in determining simultaneous optimum distribution of live cattle and dressed beef. For detailed information on data generation and methodology the reader is referred to the Ph. D. dissertation which is the basis of this report. See footnote 1, p. 1.

REGIONAL DEMARCATION, REGIONAL RECEIVING AND SHIPPING POINTS FOR FED BEEF

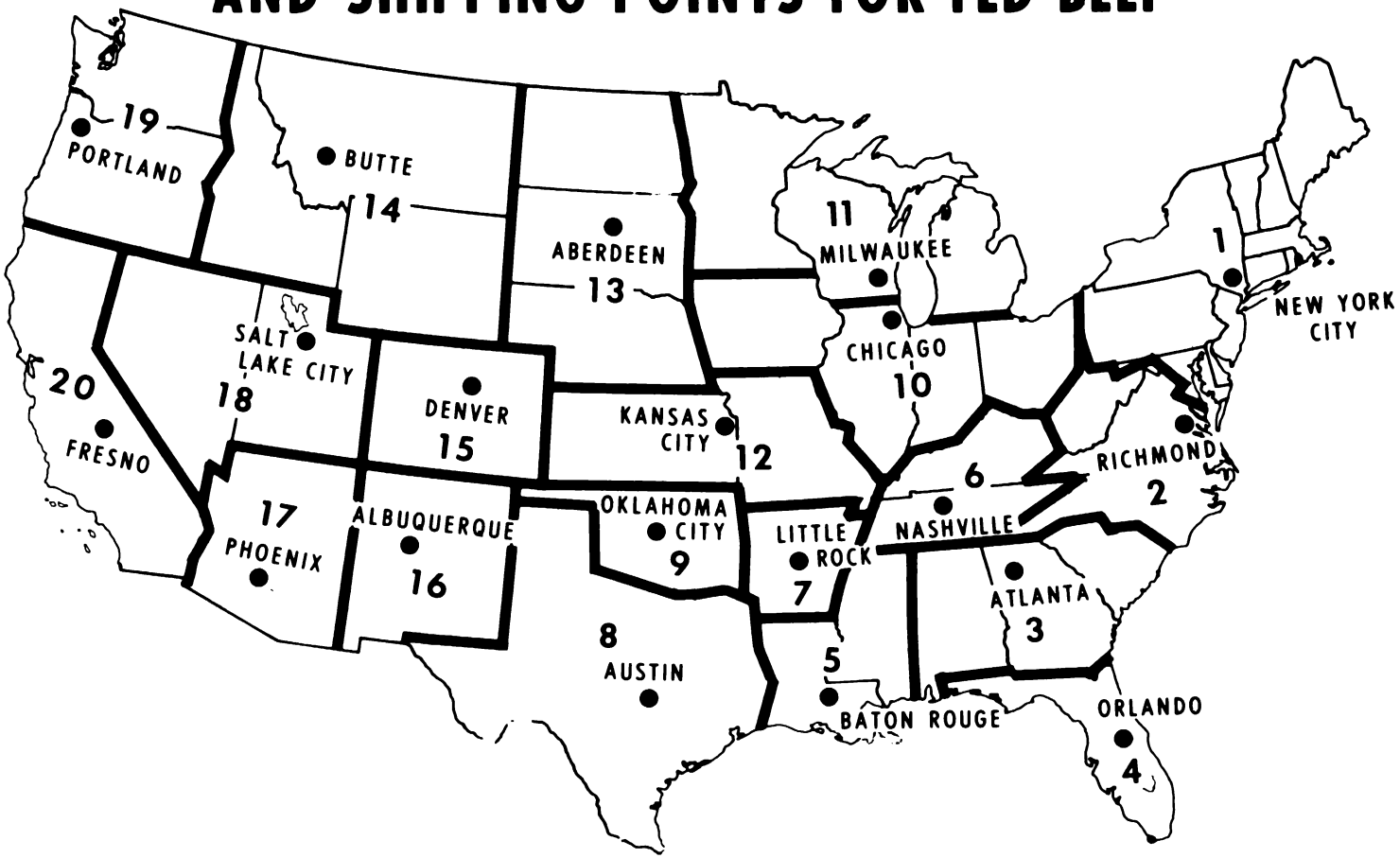

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Figure 1

THE NATURE OF INTERREGIONAL COMPETITION

Interregional competition implies a relatively free, private-enterprise economy, consisting of fairly well-defined regions differently endowed with resources. It also assumes some degree of area specialization in both production and marketing, and trading patterns among regions that are altered from time to time by changing conditions and the search for profits. It involves adjustments within areas by producers and farm-related businesses for improved bargaining power in trading. Given a competitive market structure, geographic marketing patterns are determined most immediately by interregional price differences relative to transfer costs. The regional price differences, however, are determined by regional differences in supply or demand, or both. Availability and price of resources, profit possibilities for use of resources in alternative enterprises, production techniques, and size or scale of operation also are among the factors that govern supply. The level and characteristics of demand are influenced primarily by population, per capita income, consumer preferences, and other similar factors. Thus, an interregional analysis must consider regional demand, supply, and price conditions and relationships.

Regional Production, Slaughter, and Consumption Patterns

Regional estimates of fed beef production, slaughter, and consumption for 1960 confirm many hypotheses and raise a number of interesting questions (figs. 2, 3, and 4, and table 2).8/

With a marked exception or two, fed cattle production apparently is oriented to feed production, as expected. The Northeastern quarter of the United States is the principal market area for fed beef in this country (fig. 3). Slaughter apparently is more nearly oriented to production than to consumption.

Factors other than population, it is clear, significantly affect fed beef consumption. 9/ The estimates for 1960 indicate, for instance, that the Northeast with 27.4 percent of the population consumed 31.2 percent of the fed beef; California with 8.8 percent of the Nation's people consumed 14.0 percent; but the South with 28.4 percent of the population consumed only 16.8 percent of the fed beef.

8/ Since these are estimates only and the methodology required for their computation leaves much to be desired, these data should not be considered precise or highly reliable. It is believed, however, that they represent a fairly accurate picture of conditions in 1960.

9/ See national demand equations for fed beef, Appendix I. Only per capita income, in addition to population, was given explicit consideration in development of the initial regional consumption estimates. However, since the consumption estimates in table 2 and figure 4 are spatial equilibrium results, effects of estimated regional price differentials also are reflected.

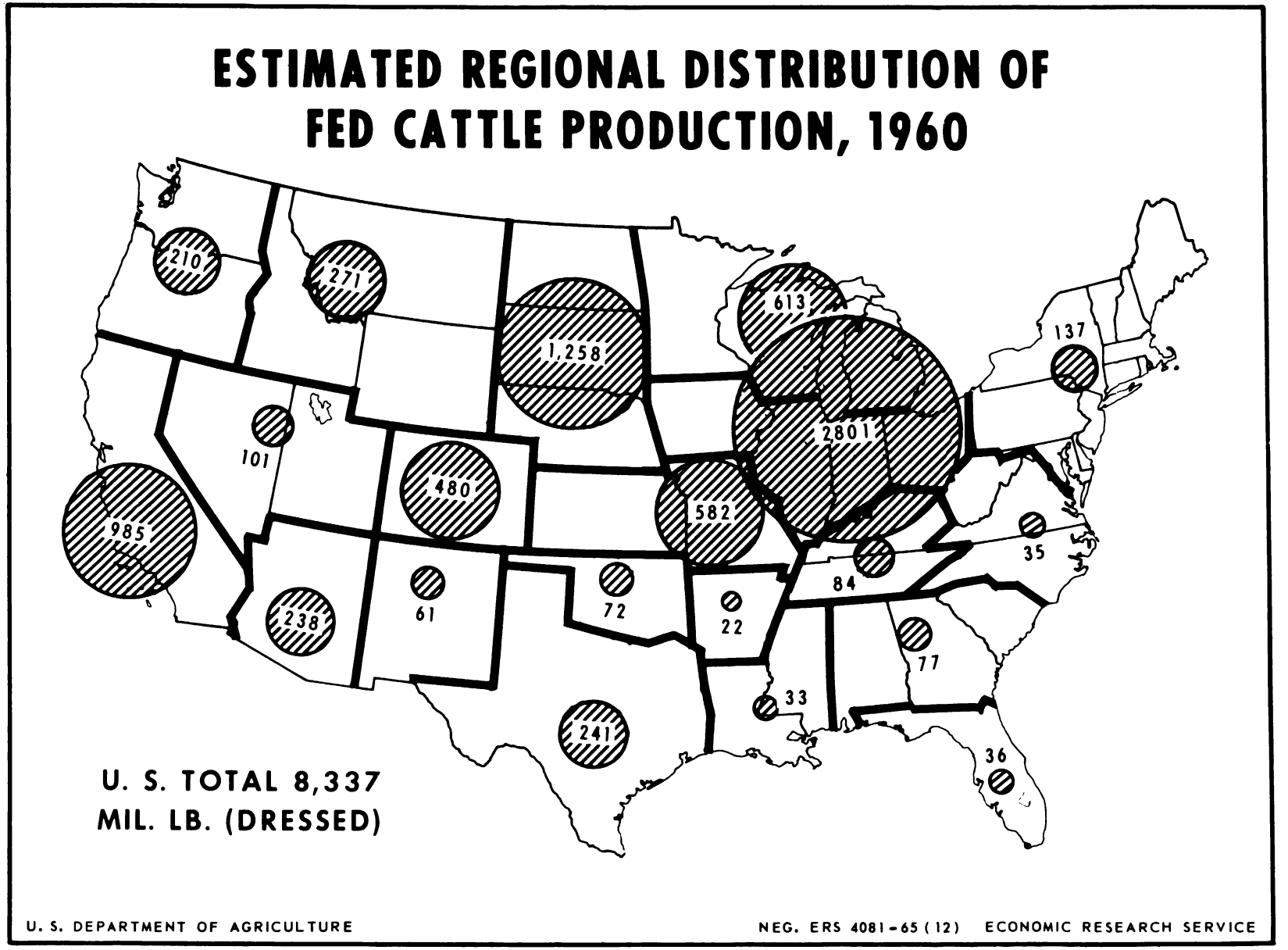
ESTIMATED REGIONAL DISTRIBUTION OF FED CATTLE PRODUCTION, 1960
210
271
1,258
613
137
2801
101
480
582
985
35
84
238
61
72
22
77
33
241
36
U. S. TOTAL 8,337 MIL. LB. (DRESSED)
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 4081-65 (12) ECONOMIC RESEARCH SERVICE

Figure 2

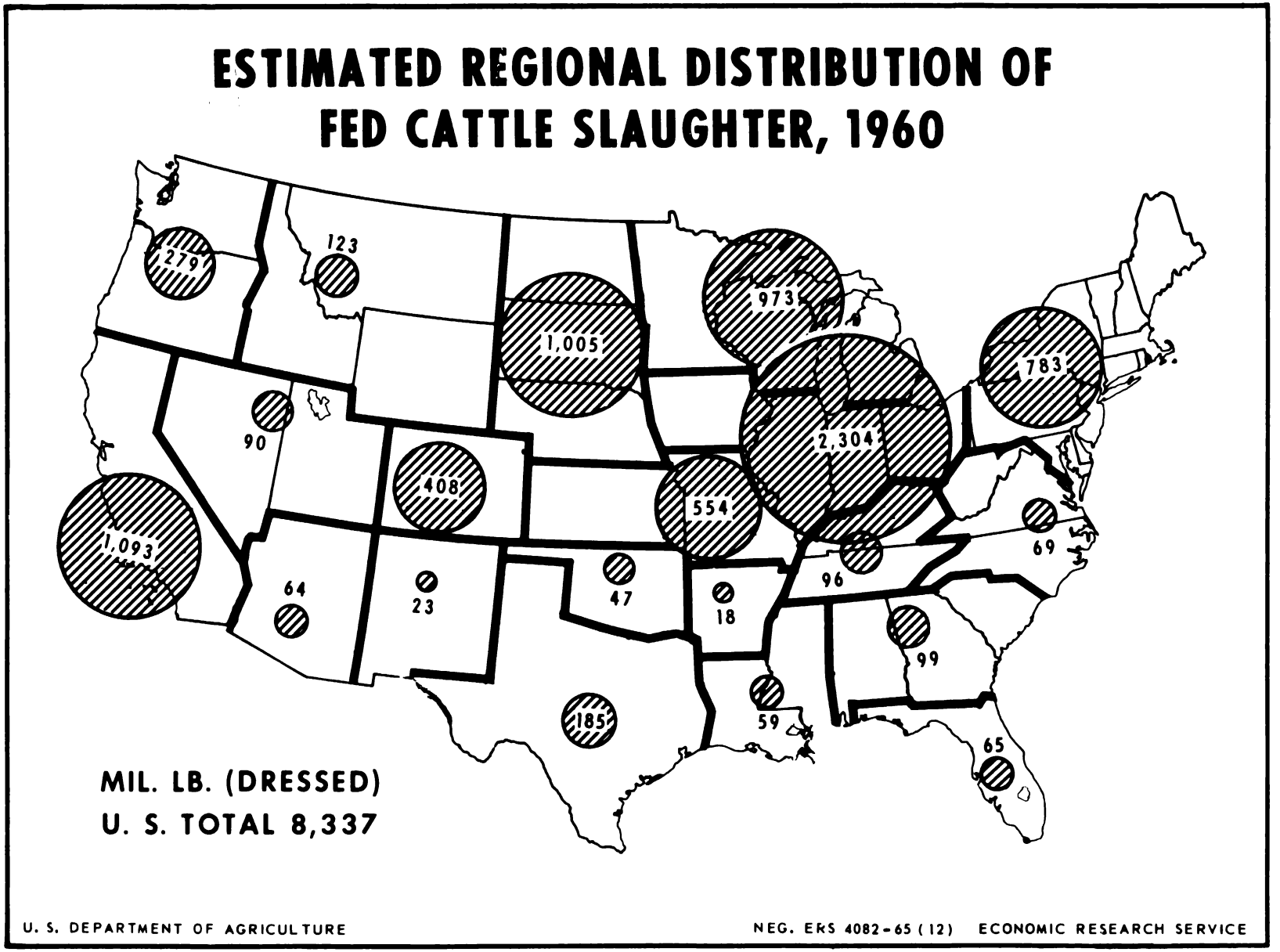
ESTIMATED REGIONAL DISTRIBUTION OF
FED CATTLE SLAUGHTER, 1960
279
123
1,005
973
783
90
2,304
408
554
1,093
69
64
23
47
18
96
99
185
59
65
MIL. LB. (DRESSED)
U. S. TOTAL 8,337
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 4082-65 (12) ECONOMIC RESEARCH SERVICE

Figure 3

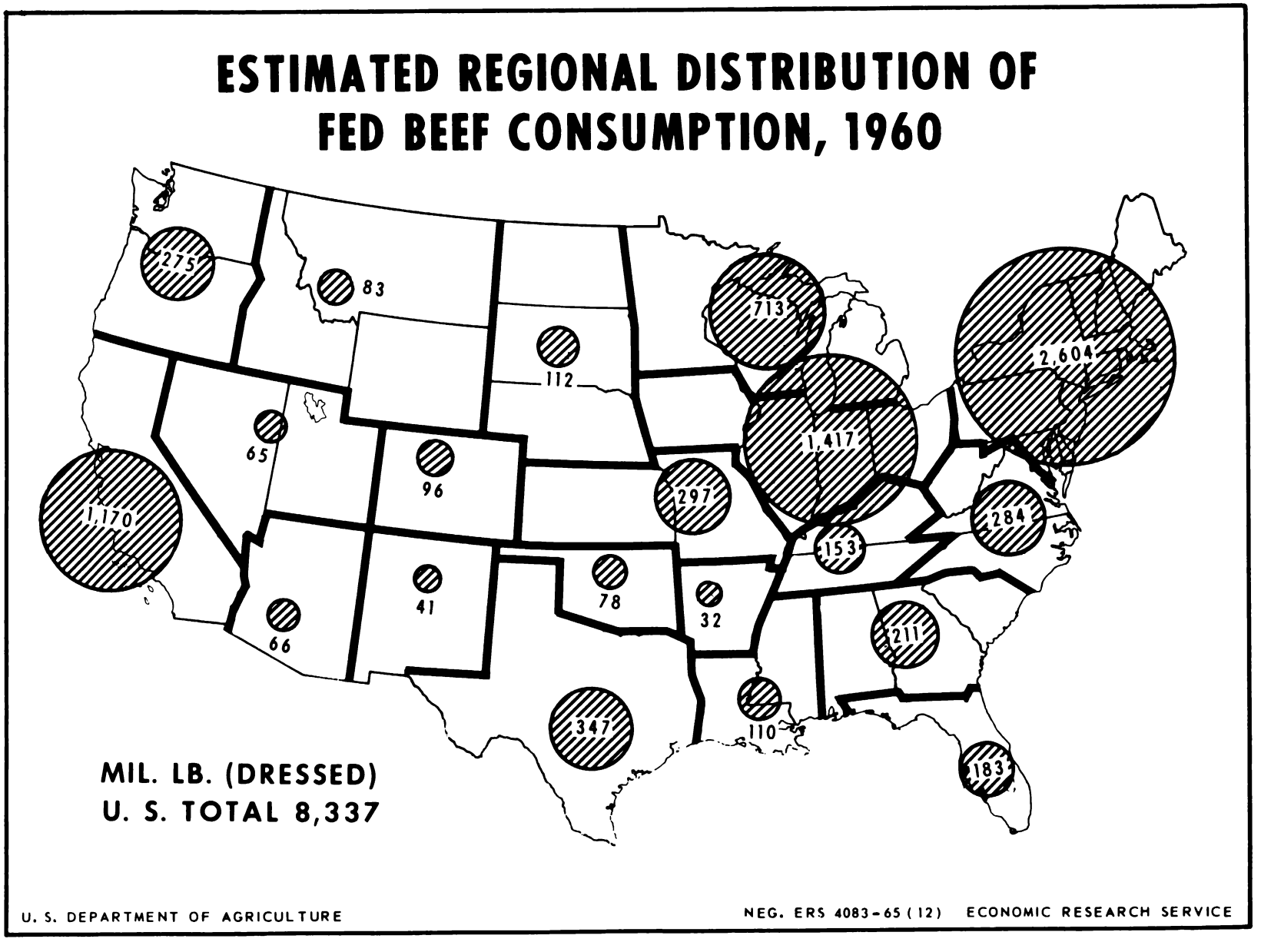
ESTIMATED REGIONAL DISTRIBUTION OF
FED BEEF CONSUMPTION, 1960
275
83
112
713
2,604
65
96
1,417
1,170
297
284
153
78
41
32
66
211
347
110
183
MIL. LB. (DRESSED)
U. S. TOTAL 8,337
U. S. DEPARTMENT OF AGRICULTURE
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Figure 4

Table 2.--Estimated production, slaughter, and consumption of fed beef, with estimated surpluses or deficits by regions, 1960

	Regions	Feedlot production	Fed beef slaughter	Fed beef consumption 1/	Surplus of fed cattle production over slaughter 2/	Surplus of fed cattle slaughter over consumption 2/
		Thousand pounds 2/				
(1)	Northeast	137,000	783,000	2,603,968	-646,000	-1,820,968
(2)	Va., W. Va., N.C.	35,000	69,000	283,570	- 34,000	- 214,570
(3)	Ala.,Ga., S.C.	77,000	99,000	210,557	- 22,000	- 111,557
(4)	Fla.	36,000	65,000	183,458	- 29,000	- 118,458
(5)	Miss., La.	33,000	59,000	110,040	- 26,000	- 51,040
(6)	Ky., Tenn.	84,000	96,000	153,311	- 12,000	- 57,311
(7)	Ark.	22,000	18,000	32,468	4,000	- 14,468
(8)	Tex.	241,000	185,000	346,944	56,000	- 161,944
(9)	Okla.	72,000	47,000	77,813	25,000	- 30,813
(10)	Ohio, Ill., Ind., Iowa	2,801,000	2,304,000	1,417,074	497,000	886,926
(11)	Mich., Minn., Wis.	613,000	973,000	713,296	-360,000	259,704
(12)	Kans., Mo.	582,000	554,000	297,014	28,000	256,986
(13)	Nebr., N.D.,S.D.	1,258,000	1,005,000	111,937	253,000	893,063
(14)	Mont., Idaho, Wyo.	271,000	123,000	83,070	148,000	39,930
(15)	Colo.	480,000	408,000	95,780	72,000	312,220
(16)	N. Mex.	61,000	23,000	40,838	38,000	- 17,838
(17)	Ariz.	238,000	64,000	66,071	174,000	- 2,071
(18)	Utah, Nev.	101,000	90,000	65,164	11,000	24,836
(19)	Wash., Oreg.	210,000	279,000	275,007	- 69,000	3,993
(20)	Calif.	985,000	1,093,000	1,169,620	-108,000	- 76,620
	U.S.	8,337,000	8,337,000	8,337,000	---	---

1/ These estimates were provided by spatial equilibrium model I.
2/ Dressed weight.

Continued industrialization and rising per capita incomes in regions such as the South could have a substantial effect on consumption of fed beef in the United States. While the income elasticity for fed beef in this country appears to have dropped somewhat, it remains relatively high. 10/ On the average in 1960, for instance, a 1 percent change in per capita income may have been associated with a 2.4 percent change in fed beef consumption. But income elasticities for fed beef appear to vary widely among the regions--more widely than for all beef--and probably are highest in low-income areas such as the South. The fed cattle industry, therefore, may have an important stake in public programs designed to improve per capita income in the Nation's lower income areas. These programs also can be expected to affect interregional competition.

The regions that generally are deficit production and slaughter areas are fairly well defined. They consist primarily of Northeastern, Southeastern, and West Coast regions (table 2). 11/ Regions with surpluses of both live and dressed fed beef, primarily the North Central regions and adjacent intermountain States, also are well defined. Questions arise, however, concerning many of the remaining regions.

Regions with a surplus of production over slaughter but an excess of consumption over slaughter logically should be areas where fed cattle production has been rising fairly rapidly. These regions should include those where slaughter might be expected to increase in the future. In the Southern Plains, for instance, fed cattle production increased more rapidly during 1958-60 than slaughtering capacities. In some areas, however, as in Arkansas, New Mexico, and Arizona, the level of consumption or other considerations may not justify additional investment in such facilities.

The Lake State region is one where fed beef slaughter generally exceeds both production and consumption. This situation may reflect the strategic location of the region between western production and eastern consumption centers, or the early establishment of plants which have effectively offset any locational disadvantages through scale economies, related slaughtering activities, or other means. In other regions, a high level of slaughter relative to production and consumption may indicate future excess slaughter capacity and subsequent reductions in slaughter.

The situations of the California-Arizona area and of Colorado and the Northern Plains are considered curious. In California and Arizona fed cattle production has increased sharply and remains high, despite substantial deficits of both feed and feeder cattle in these States. While Colorado and the Northern Plains are about as far as possible from the Nation's principal consumption

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10/ Income elasticity for fed beef as derived from the national demand equation was about 2.9 at the mean value for 1947-62 and 2.4 at the 1960 level.

11/ It appears likely that the procedures employed tended either to underestimate consumption or overestimate production for the Washington-Oregon area and Intermountain regions.

centers and must compete for markets with more advantageously located surplus areas, these regions consistently produce large surplus quantities of fed beef. In view of the location of the Southern Plains relative to markets, reasons for the sharp increases in production in this region are not entirely clear. Findings of the study throw some additional light on these questions.

Interregional Competition in Dressed Fed Beef

Given regional estimates of production, slaughter and consumption questions arise regarding specific aspects of interregional competition (1) among surplus regions for available deficit markets and (2) among the deficit regions for available supplies. These include questions regarding the form (live or dressed) in which fed beef will be shipped. At this point, however, the analysis centers on the market for the dressed product in a representative year, assuming the location of fed beef slaughter as estimated for 1960.

No regularly published data are available on dressed beef shipments and distribution patterns. Meat shipments are made in all directions to all available markets from all major slaughtering areas. But many shipments are of little research interest because they are repeated infrequently and are the result of temporary or transitory economic conditions. Some reflect time-lag differences in adjusting to changes in national supply-demand relationships, temporary and unforseen gluts or shortages at specific locations, and other market imperfections. Detailed study usually reveals distribution patterns for the bulk of the shipments that are clearly recognizable and relatively stable.

What is desired for analysis of interregional competition is information on net locational advantages and disadvantages or competitive potentials and possibilities. While detailed information of this type is not available, findings of the various models presented in this study provide useful approximations. These are found in estimated distribution patterns and regional price differentials derived under hypothesized competitive conditions so severe that total transfer costs for the United States in shipping fed beef are minimized.

The optimum distribution pattern for fed dressed beef in 1960, given the specified regional supplies, transportation cost, and demand functions, is shown in figure 5 (model I). Quantities shipped are the underlined figures shown along with equilibrium price differentials in table 3. Also shown are the opportunity costs which appear only for surplus and deficit regions between which no shipments appear. These are the reductions in f.o.b. prices, the increases in delivered prices, or the reductions in transportation costs that would have been required for entry of indicated activities into the solution. The optimum flow patterns, which suggest preferred markets and supply sources, together with the opportunity costs and price differentials, suggest the advantages and disadvantages of location.

That the optimum distribution patterns (fig. 5) conform rather well to observed patterns is more a matter of interest than of special significance. However, the findings support or lead to several important generalizations.

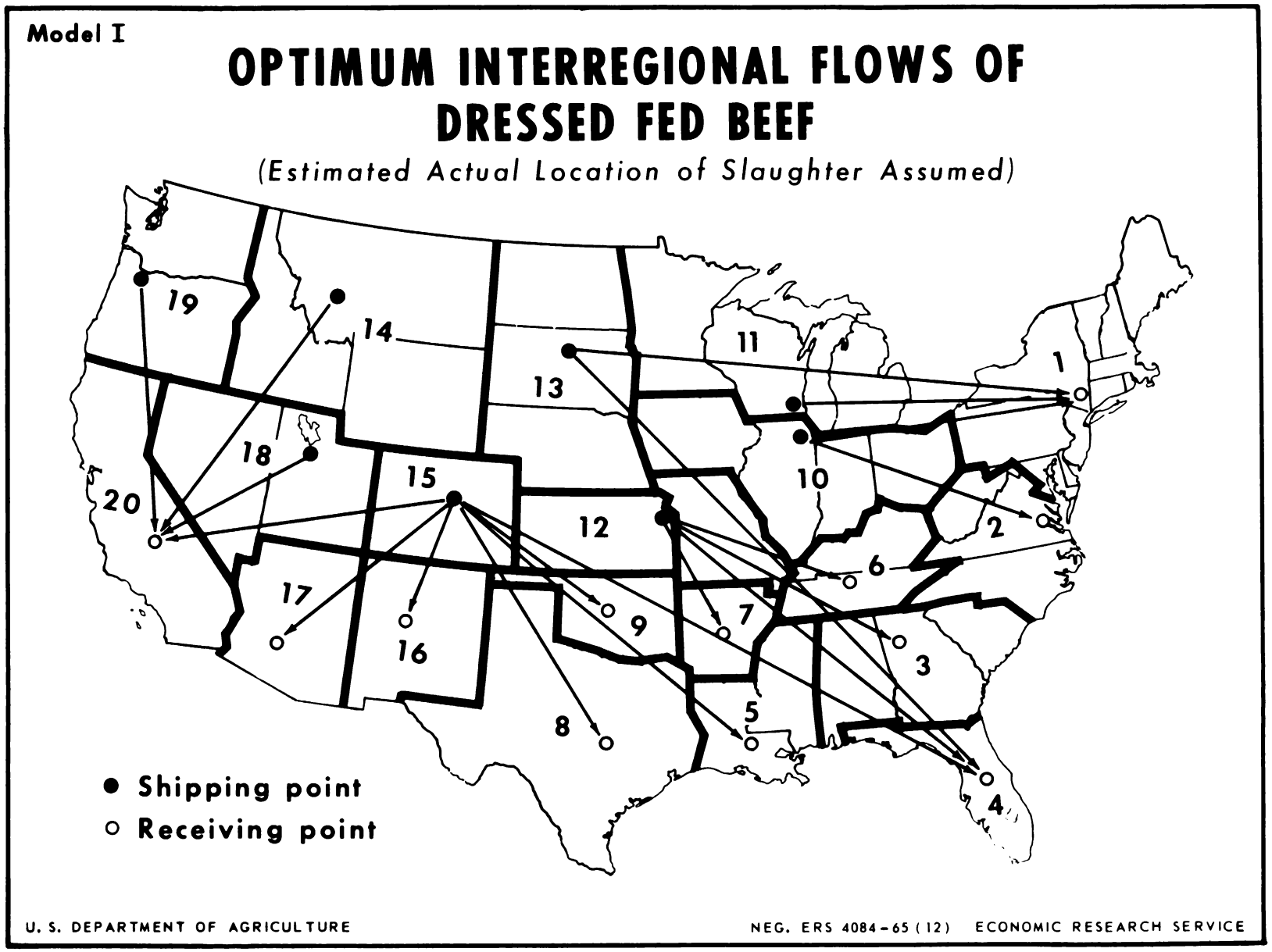
Model I
OPTIMUM INTERREGIONAL FLOWS OF DRESSED FED BEEF
(Estimated Actual Location of Slaughter Assumed)
19
14
11
1
13
18
10
15
20
12
2
6
17
9
7
16
3
8
5
4
● Shipping point
○ Receiving point
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Figure 5

Table 3.--Model I: Optimum shipments, opportunity costs, and equilibrium price differentials for dressed fed beef, assuming estimated actual slaughter location, 1960

Shipping region	Destination 1/ 1	2	3	4	5	6	7	8	9	16	17	20	Total shipped	Price diff. 2/
10...	672,356	214,570	0.17	0.26	0.76	0.16	0.86	1.69	1.63	2.93	2.84	2.70	886,926	1.22
11...	259,704	.01	.19	.22	.73	.17	.84	1.66	1.54	2.85	2.79	2.65	259,704	1.06
12...	.31	.20	111,557	73,650	.08	57,311	14,468	.62	.28	1.62	1.65	1.53	256,986	.85
13...	888,908	.03	.19	4,155	.48	.22	.31	.67	.48	1.36	1.30	.94	893,063	0
14...	1.13	1.14	1.24	.95	1.25	1.35	1.57	1.64	1.68	1.30	.66	39,930	39,930	.06
15...	.40	.36	.22	40,653	51,040	.25	.19	161,944	30,813	17,838	2,071	7,861	312,220	-.05
18...	1.84	1.94	2.02	1.58	1.61	2.05	1.98	1.60	1.82	1.26	.63	24,836	24,836	.84
19...	2.77	2.54	2.84	2.58	2.77	2.97	3.24	3.05	3.26	2.77	1.74	3,992	3,993	.85
Total...	1,820,968	214,570	111,557	118,458	51,040	57,311	14,468	161,944	30,813	17,838	2,071	76,620	2,677,658	--
Price differentials	3.14	3.04	2.70	3.54	2.58	2.21	1.91	1.99	1.43	1.05	1.83	2.79	--	--

Total shipments (1,000 pounds) = 2,677,658; total transport costs = $63,924,558; equilibrium price = $72.12 per cwt.

1/ Underscored numbers are shipments (1,000 pounds). Other numbers are opportunity costs which result from not having an activity in the optimum solution. These costs are shown in dollars per hundredweight.

2/ Differences in regional prices relative to the base region (Region 13).

The first is that location and transportation costs are important determinants of competitive market power in interregional commerce. It is apparent in model I, for instance, that Colorado and Kansas-Missouri are dominant suppliers of the deficit South where they have a locational advantage, while the Central Corn Belt has a locational advantage over all others in the Middle Atlantic area (Region 2). But the second (and perhaps more important) observation is that location relative to markets and regional differences in transportation costs to common deficit market destinations probably are not matters of overriding concern to shippers in most regions of the United States. In many instances, price differentials among surplus regions and opportunity transport costs are so small relative to fed beef prices that they frequently are offset through any of several means. However, location relative to available supplies of feed, feeder cattle, labor, and other factors of production is important. Thus, locational advantages relative to markets may be offset by lower factor or raw material prices or by more efficient rations, as well as by economies of scale, lower taxes, lower insurance rates, or depreciation, superior management, improved techniques or other means. Similarly, factors other than transportation cost are important to buyers in deficit regions, suggesting that the indicated opportunity transport costs may not greatly influence procurement patterns of large-volume wholesalers and retailers.

Another major observation is that a surplus area with clear-cut locational advantages with respect to markets of a particular deficit region usually did not increase its production enough to exclude all competing surplus regions from the market. The position of the Central Corn Belt region relative to the massive Northeastern market is a case in point. The excess demand for fed beef in the Northeast persistently exceeds the Central Corn Belt surplus by a significant margin. In the present model more than 63 percent of the excess Northeastern demand is supplied by shippers in the Lake States and Northern Plains regions. Actual records and other models show that some shippers in Colorado, the Kansas-Missouri area, and other regions also ship regularly to the Northeast.

The question is why Corn Belt producers and meatpackers do not increase their production enough to take over the Northeastern market and exclude the more distant suppliers. There are many possible reasons but logic and some research suggest two principal hypotheses. First, increasing their production of fed beef might not serve the best interests of Corn Belt producers. Producers in this region, as in other regions, are interested primarily in maximizing returns to the resources available to them. This objective may be more nearly achieved through the present allocation of resources to fed cattle production and alternative enterprises such as hog production, cash corn and soybean production, and others. Second, the locational advantages enjoyed by the Corn Belt are partially or entirely offset, as described earlier, by other factors. Lower costs in the Northern Plains or in Colorado resulting from greater efficiency or lower factor and resource prices might permit producers and shippers in these areas to compete on equal terms with the Corn Belt in the Northeast. Both explanations probably are responsible for the situation illustrated in figure 5. In the Corn Belt, cattle feeding generally is carried on by individual farmers as a secondary enterprise. In Colorado, producers specialize more than elsewhere in the feeding of heifers, which generally can be purchased at a 1 or 2 cent price advantage. The more general use of modern, scientific feeding practices in such areas, and

economies associated with large-scale organizations, also may improve the competitive situations of producers and packers in the more distant areas.

Interregional competition takes place in a dynamic environment in which the competitive market power of a region does not remain constant. Locational advantages can be lost through failure to perceive and make appropriate adjustments to changes in technology and market conditions. The future of regions with locational disadvantages depends heavily, it appears, upon (1) prospects in the more advantageously located regions for returns from alternative enterprises, and (2) rapidity with which new, cost-reducing, technological and organizational innovations and improved practices are adopted. Opportunities for product differentiation and the development of a preferred product also deserve emphasis.

Transportation Rate Relationships and Effects on Interregional Competition

Interregional economic relationships largely determine the location of processing facilities between major areas of production and consumption. They also determine the form in which the product is shipped. Among these, transportation rate relationships are of signal importance. Such relationships, however, usually are not the sole determinant.

The historical tendency in ratemaking until about 1947 was to maintain rail rates on meat that were about equivalent in terms of liveweight to the rates on livestock. As early as the 1920's the meatpacking industry was beginning to move out of the Northeast and the Eastern Corn Belt to western North Central States, because of transportation rate differences, higher shrinkage rates on livestock, and other factors such as wage rate differences. While all freight rates have risen sharply since 1947-49, rates on live animals have increased more rapidly than equivalent rates on meat. 12/ This, along with increased use of the Federal grade standards and retail specifications and other factors, has accelerated the production-oriented relocation of meatpacking facilities.

Despite rate changes conducive to relocation, a number of factors continue to encourage or require a relatively large volume of slaughter livestock shipments to deficit areas. Once established, many meatpacking plants in deficit areas continue to operate as long as revenues cover expenses and yield some profit even though larger net profits would be associated with relocation of the plant or inshipment of carcasses. Some may operate at a loss for a time if revenues are sufficient to cover variable expenses. Limitations on meatpacking plant capacity in some surplus regions, special rate relationships in some areas, and a variety of techniques such as trip leasing for undercutting the regulated rates are among factors which allow slaughter to remain market oriented.

To illustrate types of economic effects that might be associated with a difference in transportation rate structures, a model of the fed beef economy was constructed which involved the simultaneous optimum distribution of both

12/ Williams and Stout, p. 326 of reference cited in footnote 3, p. 2.

live fed cattle and dressed fed beef (model II). Since indications of effects on slaughter location were desired, the model was contrived to permit slaughter to shift within certain arbitrarily imposed limits dictated by principles of cost minimization. With emphasis on the short run, upper limits were established on slaughter for each region equivalent to estimated maximum capacities of existing facilities. 13/ In accordance with current tendencies, the live animal transportation rates employed in this model were significantly higher than equivalent rates on shipments of dressed beef. Live animal transportation rates increased more rapidly than dressed beef rates with increases in shipping distance. 14/ Thus, the model was designed to reveal tendencies for shifts in the location of slaughter as well as optimum flow patterns and the nature of interregional competition for both live fed cattle and dressed fed beef.

The overall surplus of deficit status of each region represented the difference between production and consumption in terms of dressed carcass weight. The status of each region in live cattle or in dressed beef, however, was partially determined by the optimum solution since the location of slaughter was, within limits, a part of the solution.

The model illustrates a high degree of economic interdependence among the regions (fig. 6 and table 4). It also tends to verify some hypotheses regarding shifts in slaughter location. With equivalent transportation rates significantly higher on live cattle than on dressed beef, surplus regions would be expected to increase their slaughter to capacity and to ship dressed beef whenever possible. In deficit regions, slaughter would be expected to drop, leaving unused slaughter capacity.

As anticipated, fed beef slaughter dropped significantly in the Northeast and in the Northwest (table 5). The increases for the North Central region and the Intermountain West also were fully consistent with expectations. On initial examination, however, extent of the decline in the Lake States areas, along with the appearance of substantial excess capacity in this region, and the increases for California and the South appear contrary to basic principles of cost minimization. Questions regarding reasons for transcontinental shipments of live animals arise immediately. Closer examination reveals, however, that these situations are consistent rather than inconsistent with the basic principles. The model illustrates situations in which surface expectations are not always realized.

The value of the findings lies not so much in the accuracy with which conditions for 1960 are depicted as in situations and conditions that either have existed or could exist in the future. The underlying conditions often change rapidly. For instance, the western territory that excludes Colorado

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13/ When upper limits were established for each region, lower limits, given fixed volumes of production, slaughter, and consumption, necessarily also were established.

14/ Dressed weight transportation rates were the same as those estimated by Malone, John W., A Spatial Equilibrium Analysis of the Fed Beef Economy, unpublished Ph. D. dissertation, Okla. State Univ., 1963. Rates for live cattle were derived from data obtained directly from railroads and from the North Central Livestock Marketing Research Committee.

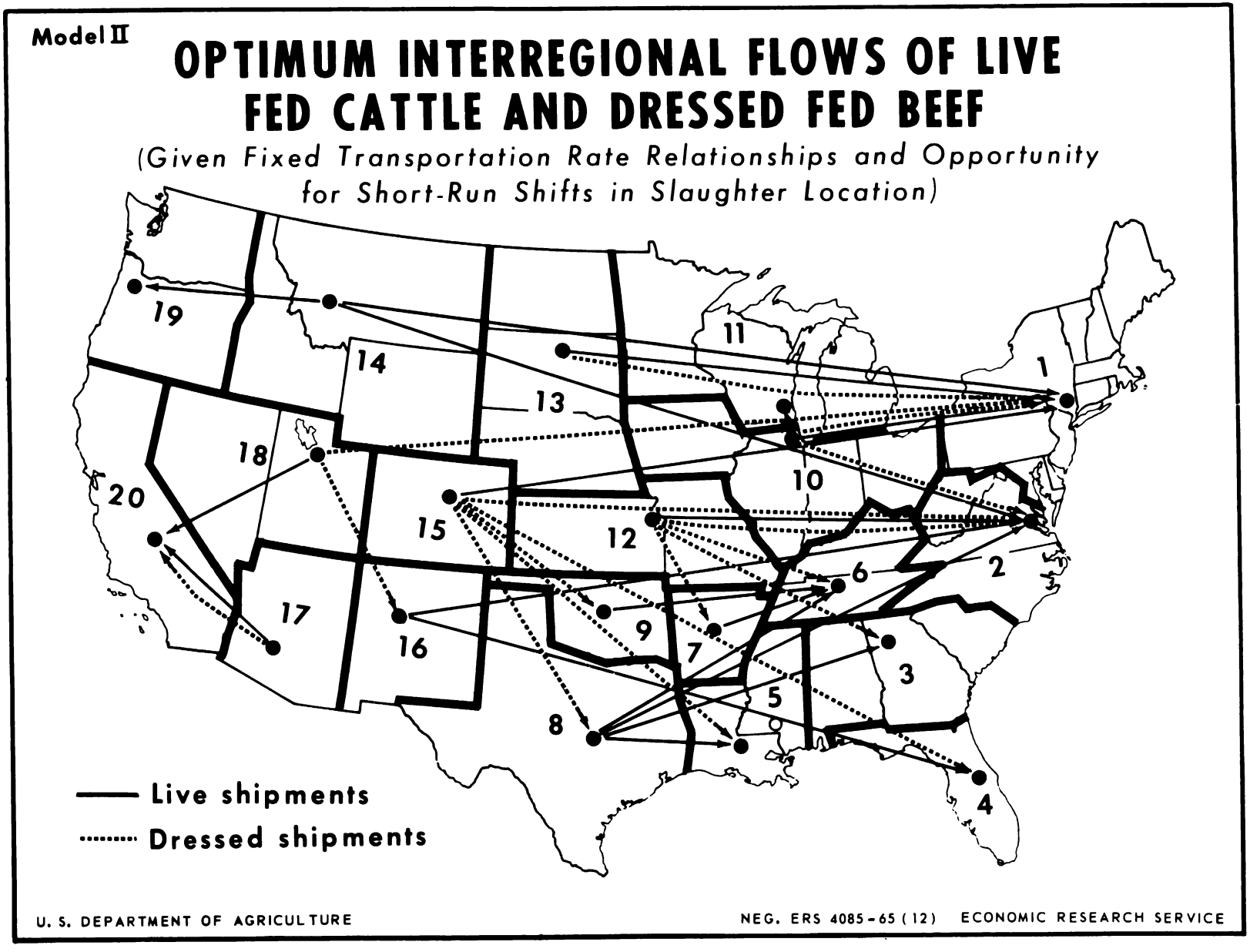
Model II
OPTIMUM INTERREGIONAL FLOWS OF LIVE FED CATTLE AND DRESSED FED BEEF
(Given Fixed Transportation Rate Relationships and Opportunity for Short-Run Shifts in Slaughter Location)
19
14
11
1
13
18
10
20
15
12
6
2
17
16
9
7
3
5
8
4
Live shipments
Dressed shipments
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 4085-65 (12) ECONOMIC RESEARCH SERVICE

Figure 6

Table 4.--Model II: Optimum simultaneous distribution of live fed cattle and dressed fed beef, and surplus slaughter capacities, by regions, 1960

Form of shipments and shipping region	Destination 1/													Total shipped
	1	2	3	4	5	6	7	8	9	11	16	19	20	
	Million pounds													
Live fed cattle (dressed equivalent):														
7	---	---	---	---	---	7	---	---	---	---	---	---	---	7
8	---	4	26	---	14	7	---	---	---	---	---	---	---	51
9	---	---	---	---	---	17	---	---	---	---	---	---	---	17
10	234	---	---	---	---	---	---	---	---	85	---	---	---	319
12	---	30	---	---	---	---	---	---	---	---	---	---	---	30
13	104	---	---	---	---	---	---	---	---	---	---	---	---	104
14	133	1	---	---	---	---	---	---	---	---	---	8	---	142
15	13	---	---	---	---	---	---	---	---	---	---	---	---	13
16	---	3	---	31	---	---	---	---	---	---	---	---	---	34
17	---	---	---	---	---	---	---	---	---	---	---	---	167	167
18	---	---	---	---	---	---	---	---	---	---	---	---	2	2
Total live	484	38	26	31	14	31	0	0	0	85	0	8	169	886
Dressed fed beef:														
10	960	117	---	---	---	---	---	---	---	---	---	---	---	1,077
12	---	93	112	---	---	39	17	---	---	---	---	---	---	261
13	1,046	---	---	---	---	---	---	---	---	---	---	---	---	1,046
14	---	---	---	---	---	---	---	---	---	---	---	49	---	49
15	---	8	---	123	65	---	---	157	21	---	---	---	---	374
17	---	---	---	---	---	---	---	---	---	---	---	---	6	6
18	23	---	---	---	---	---	---	---	---	---	13	---	---	36
Total dressed	2,029	218	112	123	65	39	17	157	21	0	13	49	6	2,849
Total shipments	2,513	256	138	154	79	70	17	157	21	85	13	57	175	3,735
Surplus slaughter capacity 1/	828	38	26	31	14	31	0	0	0	405	0	84	172	1,629
Unused slaughter capacity 2/	344	0	0	0	0	0	0	0	0	320	0	76	3	743

Total shipments (mil. lbs.) dressed = 2,849; live (dressed equivalent) = 886; total transport costs = $92,863,400.

1/ Slaughter capacity available minus regional feedlot production (dressed equivalent).
2/ Surplus slaughter capacity minus live inshipments (dressed equivalent).

Table 5.--Absolute and percentage short-run changes in slaughter volume associated with optimum simultaneous distribution of live and dressed fed beef 1/

(Differences in slaughter volume between models I and II)

Region	Absolute change	Percentage change
	Million pounds	Percent
Northeast	- 162	-20.7
Lake States	- 275	-28.3
Other North Central	+ 325	+ 8.4
Southern Plains	+ 13	+ 5.6
Other South	+ 14	+ 3.4
Intermountain West	+ 85	+12.0
Oregon-Washington	- 61	-21.9
California	+ 61	+ 5.6
Total	0	0

1/ Limitations were imposed on these shifts through assumptions regarding short-run restrictions on regional slaughter capacity.

normally is a slightly deficit producer of fed beef requiring inshipments from Colorado and some other areas. Periodically, however, western production rises relative to local consumption, encouraging larger shipments out of Colorado to deficit areas in the East and Southeast and an eastward flow from some other regions in the West. Subsequently, the associated relatively lower f.o.b. prices in the West bring about reductions there in local fed beef marketings and resumption of the westward flow. The situation described in figure 6 represents conditions in which the West, excluding Colorado, is slightly surplus. This markedly affects some of the findings.

Several of the phenomena illustrated for the West are both curious and typical of situations that often can and do exist. These include (1) the increased slaughter volume in California and the long-distance shipment of live cattle from Region 14 to the East Coast, in view of the drop in slaughter below full capacity in the Northwest, and (2) the eastward shipment from Region 18, in contrast with 14, of dressed beef rather than live cattle. One reason for these occurrences is the slight overall surplus situation of the West which requires shipments of either live or dressed beef to East Coast deficit areas. Additional

factors include (1) limited slaughter capacities in all Intermountain regions relative to production, and (2) the differing structure of transportation rates on shipments out of Utah-Nevada as compared with those for the Montana-Idaho area.

Each Intermountain region slaughters to the limits of its capacity, provides for its own consumption, and must export the remainder to other regions. With slaughter facilities operating at capacity in Colorado and in the North Central regions and with consumption fully satisfied in these regions, any western surplus must move to deficit regions on the East Coast or in the South. 15/ Arizona, under conditions of model II, is totally committed to the California market for all of its surpluses. The Utah-Nevada area has surpluses of both live cattle and dressed beef, and reduced f.o.b. prices which are attractive to California packers. The region ships dressed beef east and live cattle west, since savings on shipments of dressed beef to New York exceed the additional cost of shipping live cattle instead of dressed beef to California (table 6).

Table 6.--Model II: Transportation costs per 100 pounds dressed weight, cattle and beef shipped from Utah-Nevada (Region 18) to New York and California

Type of beef shipped from Region 18	To New York	To California
	Dollars	
Live cattle	4.65	2.18
Dressed beef	4.14	1.95
Difference	.51	.23

15/ In practice, differences among the regions in seasonal patterns of marketing fed cattle provide opportunities for additional adjustments. Peak marketings for Arizona and California, for instance, occur in the fall and early winter when producers in these States sometimes find it profitable to ship lightweight fed cattle eastward to markets in Texas.

The Montana-Idaho-Wyoming area (Region 14) is presented with an entirely different situation. The cost of shipping live cattle in any direction from Region 14, it is true, exceeds the comparable cost of shipping dressed beef. But with limitations on slaughter capacity in this region, live cattle must move in one direction or the other. The live cattle move east despite the higher transportation cost in this direction, because these shipments involve a smaller additional cost over the shipment of dressed beef than is true of live cattle shipments to Portland (table 7).

Table 7.--Model II: Transportation costs per 100 pounds dressed weight, cattle and beef shipped from the Montana-Idaho-Wyoming area (Region 14) to New York and Portland

Type of beef shipped from Region 14	To New York	To Portland
	Dollars	
Live cattle	4.48	1.90
Dressed beef	4.21	1.50
Difference	.27	.40

Model II provides the Lake States region with only enough cattle to equate slaughter with consumption, leaving a substantial amount of excess slaughter capacity. In this model, cattle were shipped to the Northeast from areas as far west as Colorado and Montana. The question is why one or more of these regions did not ship live cattle to the Lake States region where excess slaughter capacity could be used, and why the dressed beef thus produced was not then reshipped to the Northeast, reducing slaughter still further in this deficit region. The immediate answer is that the model was not designed to provide for such reshipments. 16/ But the provision was not necessary, primarily because the unit transportation cost per mile on live animals was significantly smaller for long-distance shipments than for short-distance shipments. Transportation costs on direct shipments of live cattle to the Northeast were smaller than the combined costs of shipments in live form to the Lake States region and reshipments to the Northeast in dressed form. This is a clear-cut illustration of a situation in which the location of excess slaughter facilities depends heavily upon transportation rate relationships.

16/ While the model was afflicted with methodological limitations of this nature, detailed study reveals that under conditions postulated these did not have an undue or seriously arbitrary effect on the relocation of slaughter.

The increases in slaughter volume for the deficit regions in the Southeast are explained largely by limited slaughter capacities in Arkansas, Oklahoma, Texas, and New Mexico relative to production in these regions. Although surplus production regions in the South slaughtered fed beef to the limits of their capacities, additional live animal shipments to southeastern markets for slaughter were required. At the same time, shipments of dressed beef from Colorado, the Kansas-Missouri area, and other surplus dressed beef regions were required to fill slaughter-consumption deficits in all regions of the South.

The findings for the South are fairly typical of those that have been observed during recent years. For instance, relatively large volume shipments of fed cattle from Oklahoma and West Texas to Louisiana, Mississippi, and the Southeast, despite equally large shipments of dressed beef to Oklahoma and Texas from the North Central region, have been recorded elsewhere and are observed regularly. 17/ Assuming that the estimates of production, slaughter capacity, and consumption are approximately correct, the model is correct in pointing to the need for additional fed beef slaughtering capacity in the Southern Plains, Colorado, and certain other supply areas.

EFFECTS OF SHIFTS IN SLAUGHTER LOCATION ON INTERREGIONAL COMPETITION

Numerous factors, as suggested earlier, affect the location or relocation of slaughter and processing facilities. Relocation usually is accomplished in response to changing interarea economic relationships. In turn, relocation processes and patterns introduce new forces and conditions leading to additional changes in competitive relationships among areas and to further interregional realignments.

To the extent that a shift in location of slaughter facilities contributes to a reduction in the overall costs of marketing, producers as well as consumers will tend to benefit. The savings in marketing costs, assuming a competitive market structure, will be passed along to producers and consumers in proportions depending on the relative elasticities of the demand and supply relationships. The various regions, however, may not share equally in these savings. For some regions overall marketing costs may be increased rather than reduced by the shift in slaughter location.

Effects on interregional competition of a production-oriented shift in slaughter location, as assumed here, will vary widely depending on the special circumstances under which the shift takes place. These include the regional distribution of production and consumption, the structure of transportation rates, the density of production, and economies of scale in beef slaughtering. 18/

17/ Dietrich, R. A., Williams, W. F., and Miller, J. E., The Texas-Oklahoma Meat Industry, U.S. Dept. Agr., Agr. Econ. Rpt. 39, July 1963.

18/ See Williams and Stout, Chap. 28 of reference cited in footnote 3, p. 2.

The effects also will vary depending on the extent and timing of relocation. For instance, delayed development of slaughter capacity in a rapidly expanding area of production such as the Southern Plains could result in some deterioration of the area's competitive situation. With significantly lower rates on dressed beef than on live cattle, continued dependence on live animal shipments for areas such as the Southern Plains could result in loss of preferred deficit markets. The higher rates and additional costs associated with such transportation might permit another surplus region to establish a preference for its beef within, or in deficit regions near, the Southern Plains. 19/

On the other hand, expanding slaughter capacity in regions with a sparse population of slaughter cattle can produce competitive disadvantages. In this situation, either the procurement costs (costs of buying, assembling, and transporting cattle to the plant) or the slaughter plant costs may rise. Either or both may rise to the point that any advantages associated with lower dressed beef transportation costs are more than offset. To achieve economies of scale in a region sparsely populated with cattle, an enlarged plant might need to draw cattle from a wide area. If so, a rise in procurement costs could be expected. However, high packing-plant costs might be associated with a larger number of smaller plants. Seasonal or cyclical variations in production, resulting in seasonal or cyclical excess capacity, would cause additional diseconomies in slaughtering. Regional differences in wage rates and other factor prices as well as in slaughtering techniques and degree of specialization also contribute to regional differences in slaughtering costs.

Adaptation of improved facilities and techniques for use in small packing plants has greatly reduced advantages of scale in beef packing. In addition, it is possible that some of the diseconomies and inefficiencies associated with relocation of slaughter facilities would be offset by certain types of external economies. With growth in number or size of slaughtering facilities in an area, these might include reduced electrical power rates, improved roads and highways, or establishment in the area of complementary or service industries. It is apparent, however, that cost disadvantages as well as advantages would be associated with the complete shift of the slaughtering industry in the United States to a strict production orientation. Otherwise, progress toward such an orientation might have been more rapid.

To provide insight regarding effects on interregional competition of current trends in location of fed beef slaughter, model III was developed (fig. 7 and table 8). 20/ Model III assumes that slaughter facilities shifted so that

19/ This apparently is what happened in the Southern Plains during 1958-62 when fed beef production was growing rapidly in this region and fed beef slaughter capacity was becoming increasingly inadequate. See Dietrich, Williams, and Miller, reference cited in footnote 17, p. 26.

20/ Additional models and comparisons similar to those presented here are found in Williams, Willard F., and Malone, John W., Interregional Competition in Fed Beef, Tentative Spatial Equilibrium Solutions with Implications for the Oklahoma Beef Industry, Okla. Agr. Expt. Sta., Proc. Series, P-473, March 1964.

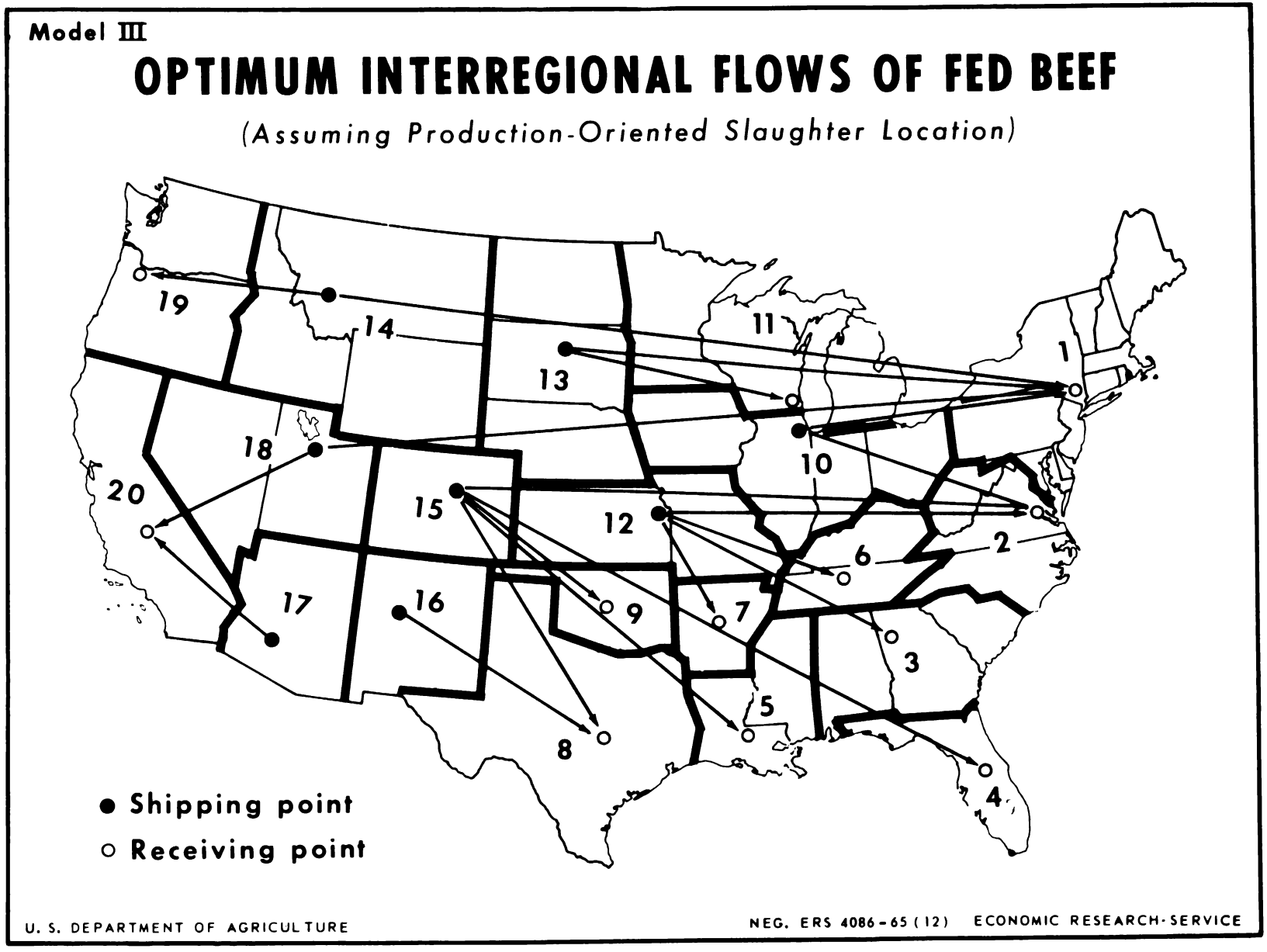
Model III
OPTIMUM INTERREGIONAL FLOWS OF FED BEEF
(Assuming Production-Oriented Slaughter Location)
19
14
11
1
13
18
10
20
15
12
6
2
17
16
9
7
3
5
8
4
● Shipping point
○ Receiving point
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Figure 7

Table 8.--Model III: Optimum shipments, opportunity costs, and price differentials for fed beef, 1960, assuming production-oriented slaughter location

Shipping region	Destination 1/												Total shipped	Price differentials 2/
	1	2	3	4	5	6	7	8	9	11	19	20		
10	1,268,984	113,997	0.37	0.62	1.12	0.36	1.06	2.05	1.99	0.04	4.73	4.54	1,382,981	1.22
12	.11	70,168	134,403	.16	.24	69,917	10,427	.78	.44	.48	3.85	3.17	284,915	.65
13	1,055,542	.03	.39	.36	.84	.42	.51	1.03	.84	90,536	2.58	2.78	1,146,078	0
14	125,610	.01	.31	.18	.48	.42	.28	.87	.91	.28	62,274	.71	187,884	-1.07
15	.04	62,731	.06	148,747	77,580	.09	.03	88,252	6,383	.28	1.90	1.48	383,693	-.41
16	.56	.66	.45	.05	.08	.63	.28	20,132	.26	1.28	2.51	1.12	20,132	-.03
17	.61	.71	.53	.25	.25	.88	.60	.07	.60	1.51	1.77	170,706	170,706	-.52
18	19,055	.10	.38	.10	.13	.41	.34	.12	.34	.52	.42	16,147	35,202	-1.00
Total	2,469,191	246,896	134,403	148,747	77,580	69,917	10,427	108,384	6,383	90,536	62,274	186,853	3,611,591	---
Price differential 2/	3.14	3.04	2.50	3.18	2.22	2.01	1.71	1.63	1.07	1.53	.43	.95	---	---

Total shipments (1,000 pounds) = 3,611,591; total transport costs = $87,802,360; equilibrium price = $72.38 (Region 13).

1/ Underscored numbers are shipments (in thousand pounds). Other numbers are opportunity costs which result from not having an activity in the optimum solution. These costs are shown in dollars per hundredweight.

2/ Differences in regional equilibrium prices relative to the base region (Region 13).

increased fed cattle production could be slaughtered within the area of production. It represents a specified set of circumstances in which no consideration is given to effects of the assumed shift in slaughter location on costs of slaughtering, the level, distribution or nature of production and consumption, or the transportation rates involved. Models I and III differ only in aspects required to accommodate the differing assumptions regarding slaughter location. Findings, therefore, consist primarily of comparisons between the models which represent effects on interregional competition flowing from (1) relative changes in the surplus-deficit status of the regions in dressed beef, and (2) changes in optimum distribution patterns. The findings illustrate typical effects, current tendencies, and several basic principles. 21/

With an extension of current trends in fed beef slaughter location toward production, several changes immediately would become apparent. Surpluses in major producing regions and deficits in consumption centers would both rise, requiring a larger volume of dressed beef shipments (table 9). In producing regions with limited slaughter facilities such as Arizona, New Mexico, and the Southern Plains, dressed beef deficits and surpluses of live cattle would be transformed into surpluses or smaller deficits of dressed beef. In contrast, surpluses in regions such as the Lake States, with slaughter capacities in excess of production, would tend to fall; some of these regions may acquire a deficit status (table 9).

The aggregate transportation cost for dressed beef would rise sharply. An increased volume of shipments and some increase in average length of haul would be the principal contributing factors to this increased cost. But with higher rates on live cattle shipments than on dressed beef, costs increases associated with dressed beef would be more than offset by reduced shipments of cattle. Comparing model III with model I, and assuming an optimum distribution both before and after the hypothesized relocation, an increase in total transportation cost on dressed fed beef of $24 million or 38 percent is indicated. The total transportation cost on live cattle, however, would drop by more than $30 million. 22/

Real transportation costs to society would drop even more with the shift to production-oriented slaughter. Out-of-pocket expenses for transportation are considerably smaller on dressed beef relative to equivalent quantities of live cattle than official rates imply. Additional savings would be realized through reduced losses due to bruising, shrinkage, tissue loss, and death that are associated with the shipment of live cattle. Inedible portions of the carcass such as hoofs, horns, hides, and inedible offal would remain in the production area or be shipped directly to specialized processing facilities.

The principal evidence of changes in competitive interregional relationships consists of the changes in price differentials shown in table 10. From

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21/ Since attention is confined in both models to dressed beef, a portion of the total supply (for some regions) in model I is ignored. Consequently, the overall effects on interregional competition probably are overstated.

22/ As revealed by the optimum solution of a transportation model depicting the live fed beef sector assuming the estimated actual location of slaughter.

Table 9.--Models I and III: Surplus or deficit of dressed fed beef, shipment patterns, and price differentials, by regions 1/

Region and model	Surplus (+) or deficit (-)	Regions originating or receiving shipments	Average price differential 2/	Average price change 3/
	1,000 pounds			
(1) Northeast:				
I	-1,820,968	10,11,13	3.14	0
III	-2,469,191	10,13,14	3.14	
(2) Va., W. Va., N.C. (Middle Atlantic):				
I	-214,570	10	3.04	0
III	-246,896	10,12,15	3.04	
(3-7) Other South:				
I	-352,834	12,13,15	2.59	
III	-441,074	12,15	2.32	-.27
(8-9) Southern Plains:				
I	-192,757	15	1.71	-.36
III	-114,767	15,16	1.35	
(10) Central Corn Belt:				
I	866,926	1,2	1.22	
III	1,382,981	1,2	1.22	0
(11) Lake States:				
I	259,704	1	1.06	
III	- 90,536	13	1.53	+.47
(12) Kansas-Missouri:				
I	256,986	3,4,6,7	.85	
III	284,915	2,4,6,7	.65	-.20
(13) Northern Plains:				
I	893,063	1,4	Base	
III	1,146,078	---	---	---
(15) Colorado:				
I	312,220	1,4,5,8,9,16, 17,20	-.05	
III	383,693	2,4,5,8,9	-.41	-.36
(14,16-18) Other Intermountain				
I	44,857	20	.95	-1.61
III	413,924	1,8,19,20	-.66	
(19) Northwest:				
I	3,993	20	.85	
III	- 62,274	14	.43	-.42
(20) California:				
I	- 76,620	14,15,18,19	2.79	
III	-186,853	17,18	.95	-1.84

1/ Model I represents conditions assuming estimated slaughter location for 1960; model III represents conditions assuming production-oriented slaughter location.
2/ Average price difference relative to the base region.
3/ Average change in price differential relative to the base region.

Table 10.--Optimum shipment patterns in selected models of the fed beef economy, and changes in optimum patterns when production and slaughter are increased in specified regions 1/

List of regions	Regions shipping to or from those listed				
	Model I 2/	Change from preceding model with increased production and slaughter in specified regions 3/			Model VI
		Model IV, increases in Regions 8 & 9	Model V, increases in Regions 8, 9, 12, 15, 16	Model VI, increases in Regions 2 to 9, 12, 15, 16	
	Assigned numbers of region				
(1) Northeast	10,11, 13	0	+15	+12	10,11,12, 13,15
(2) W.Va., Va., N.C.	10	+12,+15	-10	-15	12
(3) S.C., Ga., Ala.	12	+9	-9	0	12
(4) Florida	12,13,15	-12,-13,+8	0	+9	8,9,15
(5) Miss.-La.	15	-15,+8	0	0	8
(6) Ky.-Tenn.	12	0	0	0	12
(7) Ark.	12	-12,+9	+12	-12	9
(8) Texas	15	-15,+4,+5	0	0	4,5
(9) Okla.	15	-15,+7,+3	-3	+4	4,7
(10) Cent. Corn Belt	1,2	0	-2	0	1
(11) Lake States	1	0	0	0	1
(12) Kans.-Mo.	3,4,6,7	+2,-4,-7	+7	+1,-7	1,2,3,6
(13) No. Plains	1,4	-4	0	0	1
(14) Wyo., Idaho, Mont.	20	+19	0	0	19,20
(15) Colorado	4,5,8,9, 16,17,20	+2,-5,-8,-9	+1	-2	1,4,16,17, 20
(16) N. Mex.	15	0	0	0	15
(17) Ariz.	15	0	0	0	15
(18) Utah-Nev.	20	0	0	0	20
(19) Wash.-Oreg.	20	-20,+14	0	0	14
(20) Calif.	14,15,18, 19	-19	0	0	14,15,18

1/ See appendix tables 18-20 for data on changes in quantities shipped.
2/ Assumes estimated actual location of production and slaughter.
3/ A "+" indicates addition of the region indicated either as a market or a supply source, while "-" indicates subtraction of a region as a market or supply source. Reference is to changes from the preceding model.

the viewpoint of producers or meatpackers, all regions other than the Northeast, the Middle Atlantic, the Lake States, and the Central Corn Belt apparently would be affected disadvantageously. The West would be affected most severely. These effects, as well as those in many other regions, are the result of a special set of circumstances.

Prior to the shift in slaughter location (model I), the western territory (including the West Coast) that excludes Colorado is slightly deficit in dressed fed beef. After slaughter relocation,this western territory has a small surplus of the dressed product which must be shipped to East Coast markets. The sharp increase in Colorado's surplus, and the State's role as a point of balance and an equilibrator between East and West, adds to the surplus position of the West and conditions the results. Price differentials in all western regions, including the deficit California and Northwest regions, fall sharply.

Prices in many other regions also are affected. For instance, price differentials in all of the deficit southern regions fall. The reason is that with the shift in slaughter location and with the larger associated deficits in the South, the regions in this area accept shipments from Colorado and New Mexico where prices are now lower. As another example, lower prices in the South tend to discourage shipments to deficit South Central regions by Kansas-Missouri suppliers. These lower prices, along with the larger surplus, require Kansas-Missouri to initiate shipments to the Middle Atlantic region in competition with Colorado and the Central Corn Belt. The result is competitively lower prices for Kansas-Missouri packers.

Given a higher level of consumption,or reduced production in the West, the results would have been quite different. Prices in the West would have remained higher relative to the base region. California prices probably would have been substantially higher and effects on other deficit regions, the South for example, may not have been noticeable. This illustrates another source of instability in short-term interarea economic relationships.

The existence and significance of delicate interregional economic connections are again illustrated. Given these connections, small changes in any one region will tend to affect all. The Intermountain region and other similar regions with marked locational disadvantages relative to the Nation's principal deficit consuming regions will be most severely affected by small changes in their surplus position. These effects will become most apparent for the West at two critical points: (1) when the net surplus in the West rises to the point that eastward shipments by Colorado packers are not sufficient to balance production and consumption in the West, or (2) when production in the West falls, the region becomes deficit, and shipments from Colorado are required.

In contrast with the West, large-volume surplus regions such as the Central Corn Belt, located advantageously with respect to huge deficit markets such as those in the Northeast, generally will not be disadvantageously affected by a shift in slaughter location despite substantial increases in their surpluses. Prices for the Northern Plains are favorably affected when the Lake States region becomes a deficit area. It is partly for this reason that in the Northern Plains packers no longer find it necessary after the relocation to compete with Colorado and the Kansas-Missouri area on shipments to Florida.

Effects on price differentials of a shift in status from surplus to deficit are illustrated by the equilibrium conditions for the Lake States region (table 9). However, such increases in relative prices for deficit regions often tend to retard relocation by encouraging packing plants to remain market oriented. This means that relocation introduces economic forces which operate toward an equilibrium.

Transportation costs are considered high by both buyers and sellers of beef. Normally, however, they represent no more than 5 to 10 percent of the wholesale value of dressed beef. Even smaller changes or differences in transportation costs can cause marked and significant alterations in distribution patterns and provide additional evidence regarding the degree of instability in interregional economic relationships. With small reductions in transport costs, reductions in prices at origins, or increases in prices at destinations, the optimum model III solution would include shipments (1) from the Central Corn Belt to the Lake States in competition with the Northern Plains, (2) from Western Regions 17 and 18 to Texas or Florida in competition with Colorado and New Mexico, (3) from Colorado to Arkansas, the Middle Atlantic region, and the Kentucky-Tennessee area, all in competition with the surplus Kansas-Missouri region, (4) from New Mexico to Florida and the Mississippi-Louisiana region, and (5) from the Northern Plains to the Middle Atlantic area.

The three models also direct attention to one possible source of serious error in business decisions regarding the location of processing facilities. In some situations, such as rapid growth of production in new but deficit supply areas, large increases in processing capacity for deficit regions will be suggested by short-run economic circumstances. Construction of processing facilities in these areas generally will lag to some extent. For example, so long as fed beef production in the Southern Plains greatly exceeds slaughter capacity in this region, fed beef slaughter capacity in substantial amounts apparently will be needed in other areas of the South. But as production in newer surplus areas begins to stabilize, as it frequently does and apparently is doing in the Southern Plains, processing capacity in such areas may rise relatively and become adequate, depending on transportation rate relationships and other factors. At this time, unused processing facilities may appear in the deficit regions and stand as monuments to short-run wisdom. 23/

EFFECTS OF INCREASES IN PRODUCTION AND SLAUGHTER AT SELECTED LOCATIONS

The recent history of the fed cattle industry reveals dramatic interregional shifts in production as well as in slaughter and suggests that these shifts have been associated with marked changes in the nature of interregional competition.

23/ California might be a region where investment decisions leading to substantial development and growth of fed beef slaughtering facilities were not entirely consistent with emerging competitive requirements of the industry. But here, as in the Northeast, the "short run" was not short and it required interim investment decisions. In addition, the California packing facilities were and may continue to be supported by a substantial volume of local fed beef production.

Questions, therefore, arise regarding the nature and probable effects on interregional competition and on future interarea shifts in fed cattle production. Predictions regarding shifts in the location of production and their effects obviously cannot be made with certainty and are beyond the scope of this report. However, economic theory and findings presented earlier in this report offer clues regarding reasons for, and interregional effects of, a relative increase in production for any region. In addition, useful knowledge and insight are provided by analyses of hypothesized effects consistent with recent trends.

In general, it can be said that while a relative production increase in a region usually takes place in response to relative improvements in the competitive situation of that region, the production response tends to erase some of the competitive advantage that caused it. A sustained increase in production, therefore, requires a sustained source of competitive superiority relative to other regions. This was expressed earlier as the ability of a region to sell at competitively low prices and, at the same time, maintain net returns to productive resources and factors that will ensure their continued employment in the industry in that region.

Any factor or condition leading to a significant and sustained increase for a region in actual or expected net f.o.b. returns, other things equal, will tend toward an increase in production. 24/ The conditions might include (1) an increase in demand in the region or in other accessible regions, (2) a drop in transportation costs, (3) a decline in production costs, or (4) increases for other competing regions in production or transportation costs, or reductions for these regions in effective f.o.b. demands. Production costs are affected by the availability and prices of feed and feeder cattle as well as fixed and variable procurement, feeding, and marketing expenses. Feedlot costs, in turn, are influenced by production techniques, scale, length of feeding period, and other factors. 25/ Opportunity costs are critically important. Available land, labor, and capital resources will tend to be used in enterprises offering highest net returns.

It is apparent that many factors other than location relative to markets will influence the distribution of fed cattle production. Although net f.o.b. demands for fed beef will be highest in heavily populated deficit regions, opportunity costs for resources employed in fed cattle production also will be high in these regions. In addition, necessary feed and feeder cattle will be scarce and expensive in such regions. These disadvantages frequently are at least temporarily offset in deficit regions through improved production techniques, savings in marketing expenses, scale advantages, backhaul opportunities,

24/ This cannot be stated as a sufficient condition without many qualifications. A complete statement would give recognition to opportunity costs, complementary relationships, and many other economic as well as noneconomic factors.

25/ Recent findings indicate that economies of scale in commercial cattle feedlots are small, and are negligible for feedlot sizes above 2,500 head. See Williams, Willard F., and McDowell, James, Costs and Efficiency in Commercial Dry-Lot Cattle Feeding, Okla. Agr. Expt. Sta. Proc. series (in process).

and other avenues. Through time, however, fed cattle production would be expected to orient itself as dictated primarily by opportunity costs and f.o.b. prices of feed and feeder cattle. The western Corn Belt and Great Plains regions satisfy these criteria reasonably well.

Effects of a relative increase for a particular region in fed cattle production, other things unchanged, would be expected to appear most prominently in f.o.b. prices and in distribution patterns of the region. Lower prices would tend to reduce net returns of producers but they would encourage larger or more distant shipments. The rise in production would affect many other regions and generate a series of adjustments. The final effect on the regions under study would be determined by the nature of these adjustments.

The initial effects will differ depending on the surplus or deficit status of the region, its location, and the characteristics of the effective f.o.b. demand. 26/ An increase in production for a region with a large production-consumption deficit generally will have relatively little effect on regional price differentials or distribution patterns. In contrast, an increase which changes the status of a region from deficit to surplus usually can be expected to affect interregional competition over a wide area. This is particularly true of regions located far from major deficit market centers. Even large increases in production may have a negligible impact on price differentials and distribution patterns when the increases are confined to regions, such as the Corn Belt, with distinct locational advantages relative to markets. But production increases in any regions faced with a relatively inelastic demand for fed beef will tend to have a more pronounced effect on f.o.b. prices than where demand is less inelastic. 27/ It is partly for this reason that variations in feedlot marketings for the supply area that depends most heavily on the inelastic demand of the California market generally are associated with relatively wide price variations.

Additional spatial models were developed to test several hypotheses regarding effects on interregional competition of assumed increases in fed beef production for specified regions. 28/ The assumed increases were confined selectively to certain regions where feedlot production has been growing most rapidly or where increases might be expected. The selection also was

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26/ Many of the effects described here were observed in the preceding discussion in connection with shifts in the location of slaughter. The reason is that the hypothesized shift in slaughter location had the effect for some regions of increasing the supply or production of dressed beef.

27/ For some information on elasticity of demand for fed beef see Wallace, Arthur A., Jr., Subsectors Demand for Fed Beef: Analyses and Projections, unpublished Ph. D. dissertation, Okla. State Univ., Aug. 1964; Williams and Malone, reference cited in footnote 20, p.27; and Dietrich, dissertation cited in footnote 1, p. 1.

28/ The assumptions were based on regional projections in feedlot production.

influenced by a particular interest in the Southern Plains which was emerging as a surplus region at the time the study was undertaken. Among the questions at issue were these: (1) As surpluses develop in the Southern Plains, assuming adequate slaughter capacity, to which markets would the excess be attracted--would it tend to move westward to California, to the Northeast, or to deficit markets in the South; (2) what would be the effects on price differentials in the Southern Plains; and (3) what would be the effects on other regions? For instance, if California is to be the principal market for surplus quantities of fed beef produced in New Mexico, Texas, Oklahoma, or Kansas, then many producers in these States would need to direct their attention to production of lightweight Choice grade steers. If it is to be the Northeast, heavy Choice steers will be more appropriate. A much higher percentage of lightweight Good grade steers and heifers is preferred in the South.

Three new models were developed. Model IV is a modification of model I designed to accommodate substantial increases in production for the Southern Plains, i.e., Oklahoma and Texas. Model V is a further modification incorporating assumed increases in production for Colorado, Kansas, Missouri, and New Mexico as well as the Southern Plains. To these hypothesized increases in production, model VI adds assumed increases for the remainder of the South. 29/ By assuming, further, that the production increases were slaughtered within the area of production, hypothetical increases in slaughter also were achieved which made it possible to confine the analysis to the dressed beef sector. 30/ These models were developed and employed in conjunction with model I which assumes the estimated actual location of production and slaughter.

29/ The assumed increases were based on projections to 1965 made on the basis of trends for 1959-62 but they should not be construed as either projections or predictions. By region, the assumed increases above the estimated 1960 level of production were: Texas, 120 percent; Oklahoma, 75 percent; Colorado and Kansas-Missouri, 25 percent; New Mexico, 15 percent; Southern Regions 2-7, 50 percent.

30/ With assumed increases in production for specified regions, additional assumptions regarding total consumption, production in other regions, or both, were necessary. Since no further relative changes in production and a stable national average equilibrium price were desired, there were two alternatives. These included (1) use of a dummy region as employed in an earlier study (see Williams and Malone, reference cited in footnote 20, p.27, or (2) an assumed increase in United States consumption equivalent to the aggregate rise in production and selection of an allocation procedure. Tests of the two approaches suggested that the latter introduced fewer undesired distortions. The additional consumption, accordingly, was allocated to the regions through uniform percentage increases in disposable income for each region equivalent to the national percentage income increase necessary to accommodate the required national increase in consumption. Estimated regional income-consumption relationships were employed to transform the income increases for each region into estimated increases in consumption. This procedure tended to allocate relatively larger portions of the additional consumption to regions such as the South with higher income elasticities.

The findings, presented in figures 8-10, tables 10 and 11, and appendix tables 18, 19, and 20, can be summarized as follows: 31/

1. So long as fed beef production in the West remains high relative to consumption there, the Great Plains regions of the United States must look primarily eastward to the Northeast, the Middle Atlantic areas, and the South for markets.

(a) The South is the principal market territory for excess Southern Plains or Kansas-Missouri fed beef.

(b) A large increase in the California price differential would be required before fed beef would begin to flow westward in volume from the Southern Plains or other Great Plains regions. The required increase for model IV, which portrays the western area (including Colorado) as slightly deficit, would be about $1.50. This required change in the California price differential would vary with variations in the surplus or deficit status of the West, becoming smaller as consumption rose in the West relative to production.

(c) In the absence of changes in underlying conditions, fed beef would tend to flow toward the Northeast from the Southern Plains and Kansas-Missouri, before it would move from these regions to California. Recent events have demonstrated, however, that the basic conditions do change. During 1963-64, for instance, fed beef production in the West dropped relative to consumption, resulting in a larger westward flow of dressed beef out of Colorado and encouraging shipments of both live and dressed beef from Texas and some other Great Plains areas to California.

(d) The competitive position of the Northern Plains in markets of the Northeast apparently depend primarily on opportunity cost relationships among farm enterprises in the Central Corn Belt region. A sharp and sustained decline in net returns from hog production in the Corn Belt could place the Northern Plains in a precarious competitive situation in the production and marketing of fed beef.

(e) Colorado apparently will remain a formidable competitor of all other surplus supply areas in markets throughout the southern and southwestern portions of the United States. This statement is based partly on historical evidence that Colorado has maintained a high and increasing level of production despite its location and despite increased production in areas closer to markets.

2. With the emergence of the Southern Plains as a surplus region, numerous changes would develop in optimum distribution patterns (table 10).

31/ It should be understood that the following statements are made subject to certain qualifications. They are valid only within the framework of conditions as estimated or assumed. While these can be considered reasonably realistic, they do not consider the rather wide seasonal and annual variations that take place in production, in the regional distribution of production and slaughter, and in prices.

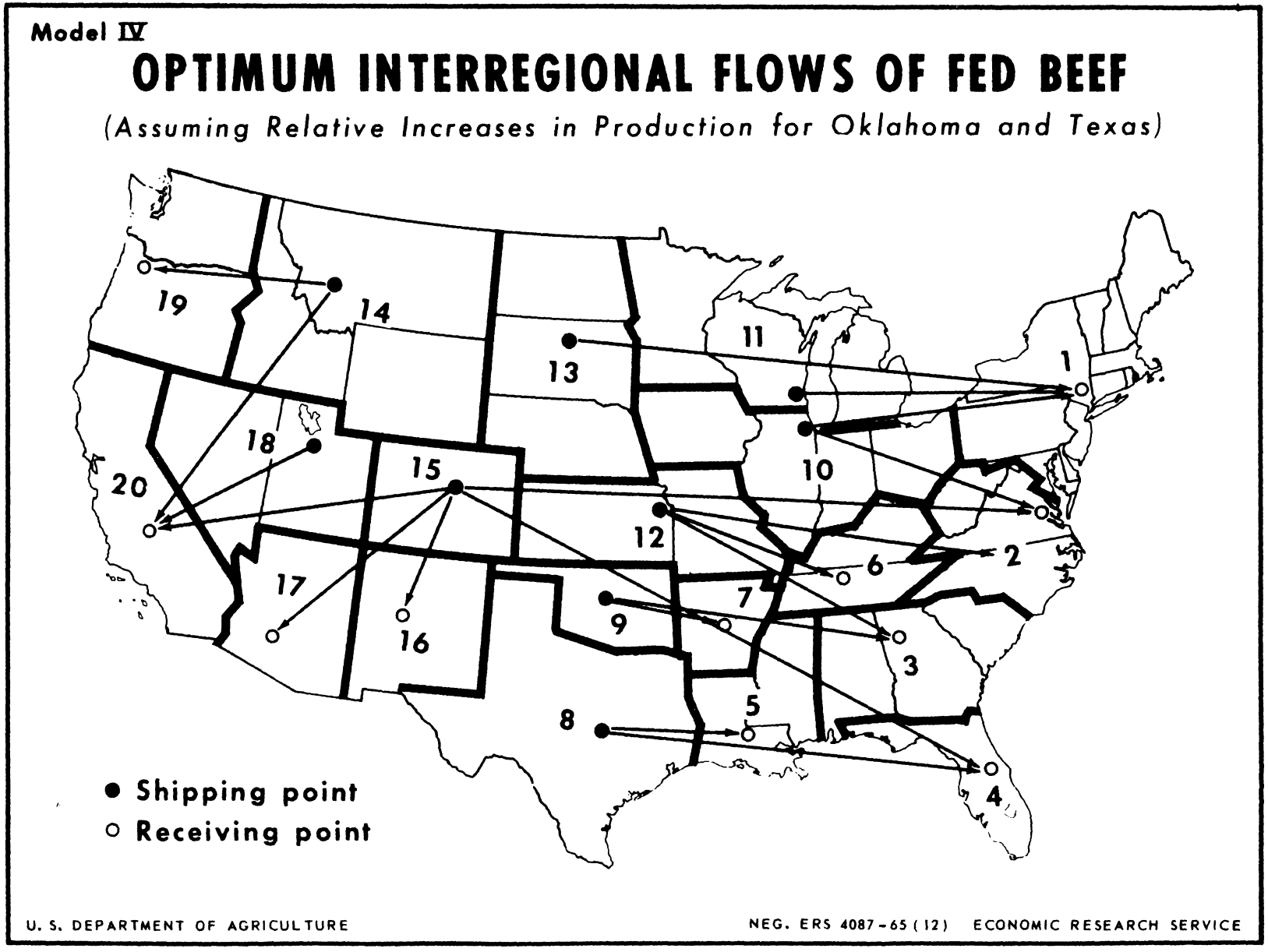
Model IV
OPTIMUM INTERREGIONAL FLOWS OF FED BEEF
(Assuming Relative Increases in Production for Oklahoma and Texas)
19
14
13
11
1
18
20
15
10
12
6
2
17
16
9
7
3
8
5
4
● Shipping point
○ Receiving point
U. S. DEPARTMENT OF AGRICULTURE
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Figure 8

Model V

OPTIMUM INTERREGIONAL FLOWS OF FED BEEF

(Assuming Relative Increases in Production for the Southern Plains, Colorado, Kansas-Missouri, and New Mexico)

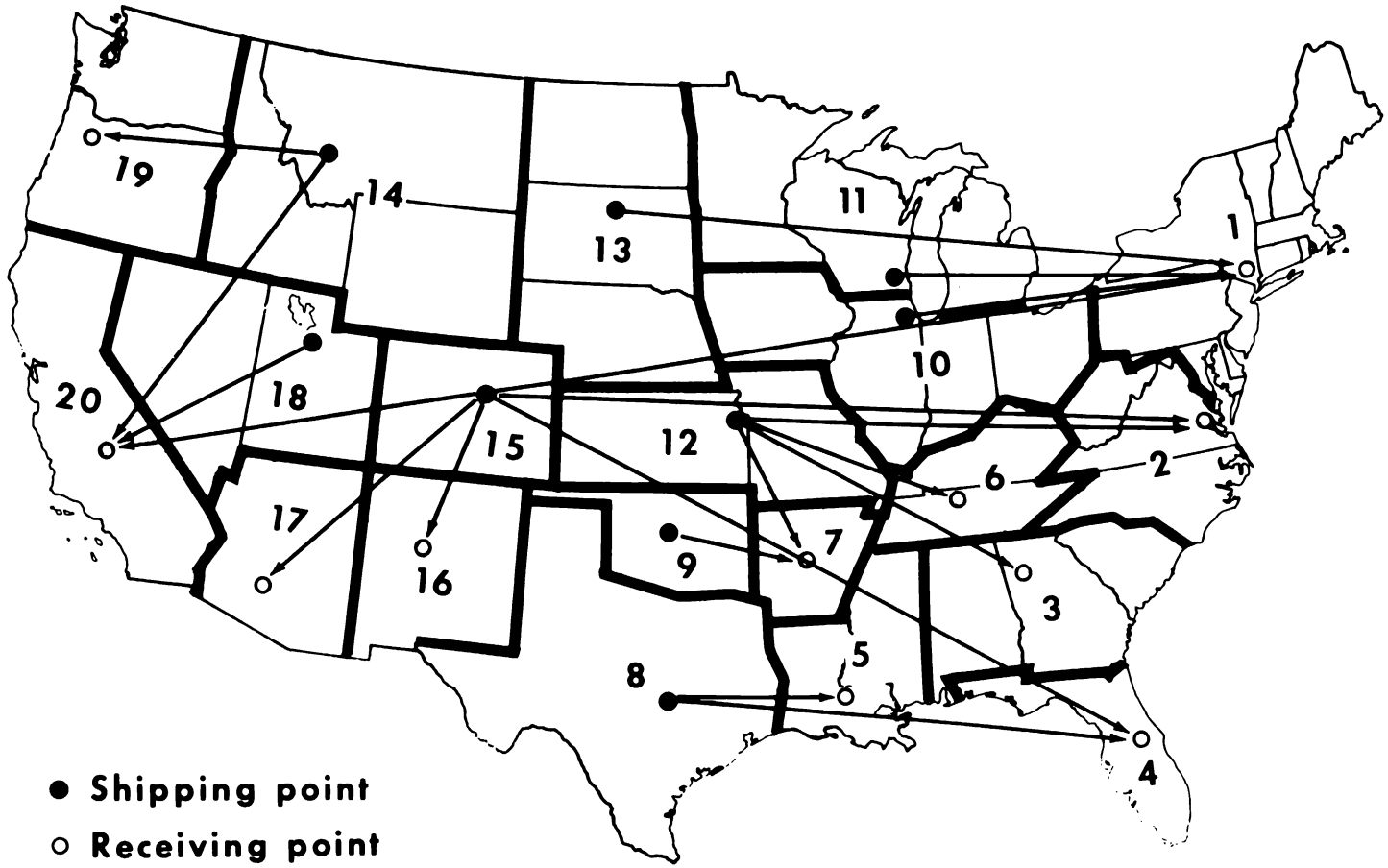

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Figure 9

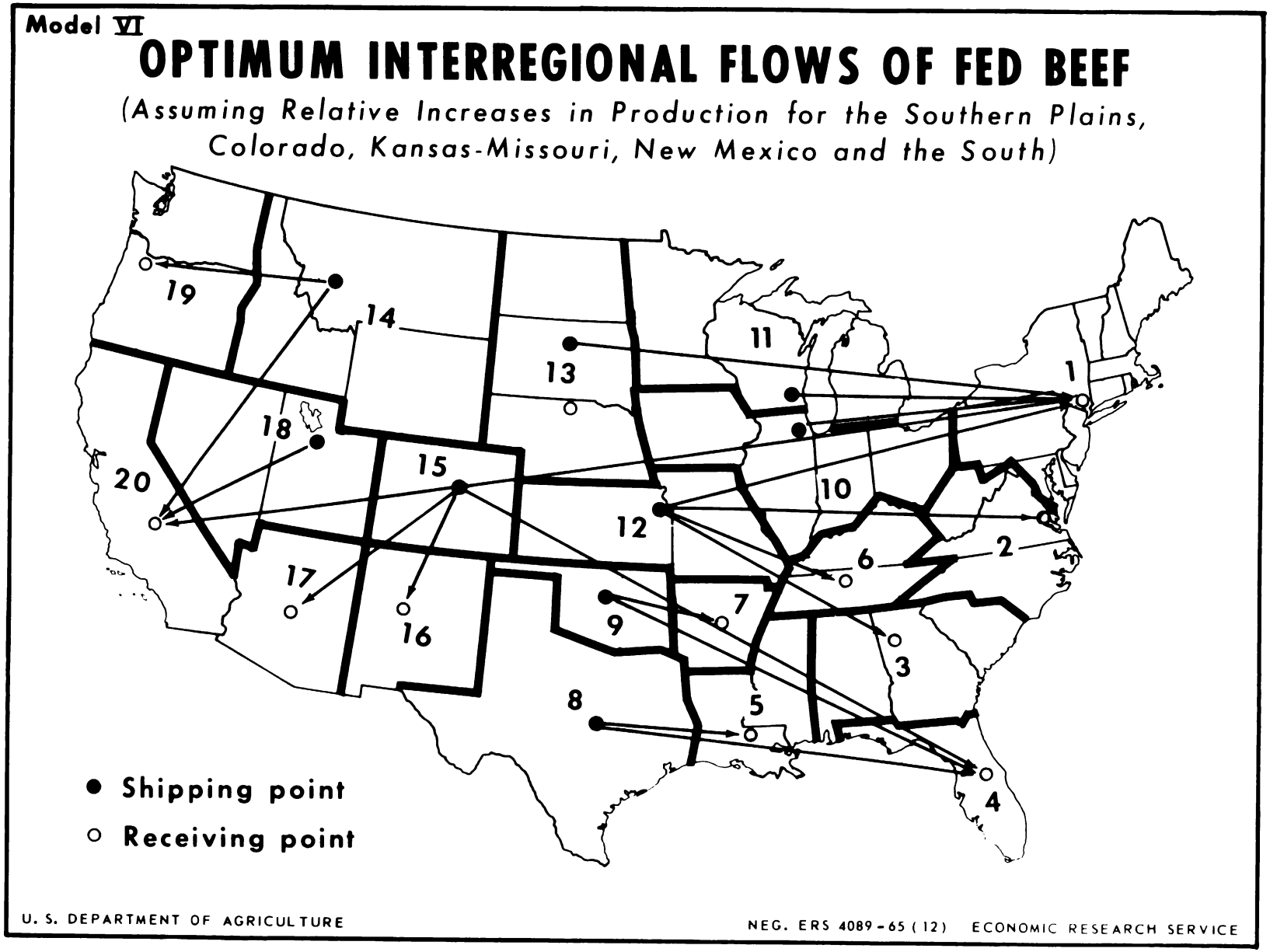
Model VI
OPTIMUM INTERREGIONAL FLOWS OF FED BEEF
(Assuming Relative Increases in Production for the Southern Plains, Colorado, Kansas-Missouri, New Mexico and the South)
19
14
13
11
1
18
15
10
20
12
6
2
17
16
7
9
3
8
5
4
● Shipping point
○ Receiving point
U. S. DEPARTMENT OF AGRICULTURE
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Figure 10

Table 11.--Interregional price differentials in selected models of the fed beef economy, and changes in differentials when production and slaughter are increased in specified regions 1/

Region	Price differential from base region				
	Model I 2/	Change from preceding model, with increased production and slaughter in specified regions 3/			Model VI
		Model IV, increases in Regions 8 & 9	Model V, increases in Regions 8, 9, 12, 15, 16	Model VI, increases in Regions 2 to 9, 12, 15, 16	
	Dollars				
(1) Northeast	3.14	0	0	0	3.14
(2) Va., W.Va., N.C.	3.04	0	-.04	-.07	2.93
(3) S.C., Ga., Ala.	2.70	-.20	-.04	-.07	2.39
(4) Florida	3.54	-.36	-.04	0	3.14
(5) Miss.-La.	2.58	-.80	-.04	0	1.74
(6) Ky.-Tenn.	2.21	-.20	-.04	-.07	1.90
(7) Ark.	1.91	-.43	+.19	-.30	1.37
(8) Texas	1.99	-1.35	-.04	0	.60
(9) Okla.	1.43	-.90	+.19	-.30	.42
(10) Cent. Corn Belt	1.22	0	0	0	1.22
(11) Lake States	1.06	0	0	0	1.06
(12) Kans.-Mo.	.85	-.20	-.04	-.07	.54
(13) N. Plains	Base	Base	Base	Base	Base
(14) Mont., Idaho, Wyo.	.06	-.36	-.04	0	-.34
(15) Colorado	-.05	-.36	-.04	0	-.45
(16) New Mex.	1.05	-.36	-.04	0	.65
(17) Ariz.	1.83	-.36	-.04	0	1.43
(18) Utah.-Nev.	.84	-.36	-.04	0	.44
(19) Wash.-Oreg.	.85	+.35	-.04	0	1.16
(20) Calif.	2.79	-.36	-.04	0	2.39

1/ See appendix tables 19-21 for other price differentials, and for shipment volumes and opportunity costs.

2/ Assumes estimated actual location of production and slaughter.

3/ A "+" indicates a rise and a "-" a drop in the price differential relative to the base. Reference is to changes from the preceding model.

(a) Increased shipments into the South by Oklahoma and Texas would tend to replace shipments to this area by competing surplus regions such as Kansas-Missouri, Colorado, and the Northern Plains.

(b) Distribution paths fanning toward the Southeast from these competing surplus regions, in effect, would be shifted northward toward markets in Middle Atlantic and Northeastern deficit regions.

(c) Increased shipments to the northeastern quarter of the Nation by Middle and Northern Great Plains regions would divert attention of shippers in Colorado and Northern Intermountain areas to West Coast markets. This would increase the supply of fed beef in the West relative to consumption.

(d) Thus, all regions of the United States would be affected by production increases for the Southern Plains.

3. Additional increases in production for Colorado, Kansas-Missouri, and New Mexico would modify and, at the same time, intensify these effects on distribution patterns.

(a) These additional increases would retain larger portions of the South as markets for Colorado and Kansas-Missouri.

(b) But they would also concentrate attention of shippers in Colorado and throughout the North Central region on the Northeast and, simultaneously, increase supplies in the West.

4. Under these conditions, production increases in the South would increase the competition among suppliers for markets in the Northeast.

5. Changes in prices and price differentials for the various regions would reflect the changes in interregional economic relationships (table 11).

(a) Relative to prices in Northeastern and Northern North Central region , f.o.b. prices in all other regions would tend to fall.

(b) As expected, the relative price reductions would be greatest for Oklahoma and Texas and in regions served directly by the Southern Plains (table 11). It is here, of course, that production presumably increases most sharply and where a change in status from deficit to surplus is involved.

(c) Colorado and other western regions, including deficit market areas, also would be uniformly affected.

In the models, effects on interregional competition of the hypothesized changes in production appear great. All other things equal, a change of even a few cents per hundredweight in the f.o.b. price in a surplus region can markedly affect such things as (1) the willingness or ability of shippers in that region to compete with other suppliers for markets in a particular deficit area, (2) distribution patterns ultimately adopted, and (3) the type of fed beef produced.

But other things are not equal among regions and do not remain unchanged through time. The competitive situation of a region depends not so much on relative f.o.b. prices as on the ability of producers and marketing firms in a region to maintain a level of net returns to resources consistent with the present or an expanding volume of production. Thus, as the Southern Plains becomes a surplus region, its competitive situation will depend on (1) the adjustment possibilities and alternatives to lower f.o.b. prices, and (2) the willingness and dispatch with which the required adjustments are made.

Relative to the wholesale value of beef and in view of the adjustment alternatives normally available to a region, a price change of $0.50 or even $1 per hundredweight is not large. Price changes of this magnitude can often be offset through several means. These include more judicious practices in buying feeder cattle, improved efficiency in the operation of feedlots, adoption of improved practices for reducing shrinkage and loss in shipping cattle, improved efficiency in the slaughter of cattle, more effective and less costly merchandising practices, and reductions in transportation rates on feeder cattle, feed, or finished cattle. Normal seasonal variations in prices of feeder cattle and fed beef exceed most of the changes in price differentials encountered in this study. This means that seasonal adjustments in the timing of purchases and sales may be sufficient to offset price disadvantages associated with location relative to markets.

The ability and willingness to make needed adjustments, however, depend even more basically on the availability and price of necessary resources. These include, most prominently, feed and feeder cattle. But they also include management skill. Capital resources and the financial ability to weather long periods of low prices have also become increasingly important.

EFFECTS OF SLAUGHTER COST DIFFERENTIALS ON INTERREGIONAL COMPETITION

In the agricultural industries, fabricating and processing costs are as important in interregional competition as production or transportation costs. Regional differences in processing costs often affect decisions regarding location of production as well as of processing. It can be hypothesized, therefore, that costs of slaughtering, the principal processing costs in the production of fresh beef, might have an important bearing on interregional competition in the fed beef industry.

Slaughtering costs have numerous components and are affected by many factors. In this study, data limitations and other considerations restricted the analysis to wage rates and average output per plant. It was assumed that regional differences in costs of slaughtering were explained by regional differences in wage rates and average output per plant. 32/

32/ Initial regional estimates of labor costs per head were derived from a California study by Logan and King where data on these costs were presented for several different plant volumes by size of plant. Logan, Samuel H., and King, Gordon A., Economies of Scale in Beef Slaughter Plants, Calif. Agr. Expt. Sta., Giannini Found. Rpt. No. 260, 1962. In our study we assumed that the plants in regions with an average output per plant similar to that of firms in California had similar physical labor requirements. The initial estimates were then adjusted to reflect regional differences in production labor wage rates.

The cost differentials associated with volume or scale of plant were lowest in the North Central region and Colorado where the average size of plant is large and highest in the South where the average plant is small (table 12). In contrast, the differentials associated with average wage rate differences were lowest in the South and highest in the North Central region, Colorado, and California. The two sources of cost differences, therefore, tended to offset one another (table 12). 33/

The slaughter cost differentials themselves suggest the extent to which they might contribute to or offset regional f.o.b. price differences. The contribution was so small that, in models incorporating the estimated slaughter cost differentials, optimum distribution patterns were not affected significantly. Several considerations suggest, however, that slaughter cost differentials are considerably more important in interregional competition than implied by the data reported in table 12.

It is probably correct to say, with reference to the meatpacking sector, that plant size and wage rates tend to offset one another in interregional competition. But marginal cost differences may be most important in determining competitive potentials. At least a few large, efficient plants are found in all regions. When such plants also have access to low-cost labor they obviously command some of the strategic requirements for competitive superiority. Nevertheless, it probably is not correct to imply, as table 12 does, that (1) the larger plants in low wage areas, such as the South, generally enjoy large cost advantages, or (2) small plants in high wage areas usually have large cost disadvantages. Such statements imply too much, since trade union activity and fringe benefits tend to increase with plant size. National packers, for example, operate in the South, as elsewhere, subject to terms of uniform national wage contracts. The larger southern plants of these packers and others often compete with smaller local plants which enjoy the advantages of lower wages, fewer fringe benefits, and flexibility in use of labor associated with access to unorganized labor markets.

Factors other than plant size that contribute to packing plant efficiency must be considered. Many of these, including technological innovation, organization, and use of plant facilities along with managerial ability, specialization, and access to external economies, were mentioned earlier. Differences in Federal and State meat inspection requirements, use of special services such as those provided by the Federal Meat Grading Service and private market reporting services, taxes, depreciation, and costs of expendable supplies contribute to regional plant cost differences.

Efficiency in packing, however, is not sufficient to guarantee competitive superiority. Market structure, resource costs, and distribution costs must be considered also. The fed beef slaughtering plants that appear to have achieved

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33/ This suggests that wage rates and scale are inversely related in meatpacking. It is possible, for instance, that low wage rates and low labor efficiency partially explain the small average size of plant in the South. No attempt was made in this study to determine or to examine the character of any such relationship. Interest centers here, instead, on effects of the observed coincidence.

Table 12.--Estimated cattle slaughtering cost differentials per hundredweight attributable to regional differences in volume per plant and wage rates 1/

Region	Differentials from base region associated with regional differences in--		
	Average output per plant	Wage rates	Combined output and wages
	Dollars		
1	0.16	-0.09	0.07
2	.22	- .46	- .24
3	.39	- .35	.04
4	.31	- .39	- .08
5	.36	- .36	0
6	.28	- .16	.12
7	.39	- .43	- .04
8	.23	- .21	.02
9	.34	- .16	.18
10	- .02	0	- .02
11	- .03	.07	.04
12	.01	- .04	- .03
13 (base region)	0	0	0
14	.16	- .14	.02
15	0	- .01	- .01
16	.28	- .30	- .02
17	.22	- .12	.10
18	.17	- .04	.13
19	.16	- .04	.12
20	.07	.05	.12

1/ Estimated regional slaughter costs are shown in columns 2 and 3 of appendix table 16. Plants slaughtering cattle often slaughter hogs, sheep, or calves. These costs, therefore, may reflect, to some extent, the slaughter volume of other species as well as cattle.

a degree of competitive superiority today have several distinctive characteristics. They are modern, specialized, large-volume plants, located in principal areas of feedlot production where adequate supplies of uniform-quality cattle can be ordered by telephone. Such plants have achieved a degree of recognition in markets as dependable suppliers of a uniform-quality product. They ship primarily in carlot quantities directly to large-volume wholesale or retail outlets. They are strategically located and organized for purposes of minimizing aggregate procurement, plant, and distribution costs and, at the same time, of providing desired marketing services. The importance of these and other considerations in interregional competition has not been fully established. But many, it is clear, are sufficient to offset advantages associated with wage rates or plant size.

Small interregional differences in cost become increasingly important as the agricultural industries become more commercial, more mechanized and specialized, and more competitive. Rapid adjustments in numbers, sizes, and types of beef packing plants, therefore, may be required in some areas if they are to remain competitive. For instance, the Southern Plains region, which ships live cattle long distances to deficit regions for slaughter, may need to develop additional specialized federally inspected facilities. The continued existence of many of the smaller nonfederally inspected plants throughout the South can be attributed largely to three factors. These are (1) the availability of low-wage, non-union labor, (2) the permissiveness and lower costs associated with State meat inspection requirements, and (3) the continued existence of many small, local retail meat outlets. But fundamental changes are affecting each of these three factors. Wages in packing plants probably will become more uniform. Lax or permissive State and local meat inspection requirements have been under fire for several years and the smaller retail outlets are disappearing rapidly. Changes in the organization, structure, and location of the meatpacking industry are inevitable.

SELECTED IMPLICATIONS

With rising interest in regional economic development in the United States, such regional characteristics as the quantity and quality of physical and human resources, resource development, the physical requirements for increased farm production and industrialization, and local adjustment problems, have received much detailed evaluation. However, less attention generally is accorded to interregional competition and to interregional relationships affecting industry location. This is unfortunate, because the wisdom and permanence of many public and private investments for regional development often depend heavily upon the attention given to delicate interregional economic connections. The reason is that such development takes place within a highly dynamic economic environment in which recognition of and adjustments to constantly changing interregional economic relationships are essential.

The dynamic economic environment of the fed beef industry is widely recognized. Changes and interregional shifts in demand, supply, costs, location of meatpacking, wage rates, transportation costs, and other factors affecting interregional competition have been described and some have been analyzed in this report. The changes include alterations in traditional regional differences in access to advanced technology and in availability and cost of feed and feeder cattle.

All of these and other factors contribute to an evolving competitive situation among the differently endowed regions. Competitive relations among deficit regions for available supplies, ordinarily neglected, are economically significant and deserve more detailed study. While the changing competitive interconnections among surplus producing regions are of more direct interest to agriculture, all such changes require adjustments in production, processing, and distribution patterns and practices. The interrelationships are so delicate that small changes in one region may require adjustments in many others.

The more dramatic current and emerging interregional conflicts are clearly evident. The eastern and western Corn Belt regions, for instance, now compete actively for the vast market of the Northeast. Competitively low costs in the western Corn Belt and in the Northern Plains areas and high opportunity costs in the eastern Corn Belt have permitted production to grow more rapidly in the western portion of the Corn Belt. These conditions may not continue indefinitely as production in the North Central and Plains regions rises relative to consumption in the Northeast. It is clear, however, that the wisdom of many future investment decisions will rest heavily on the nature of changes in competitive relations among areas of the North Central region.

In the western half of the Nation, the principal competition is between the established feedlot industry in California and Arizona, on the one hand, and that in the northern and southern Great Plains, on the other. Cattle feeding in California and Arizona competes for resources with several other enterprises. In addition, the cattle feeding industry in that area relies on distant regions for supplemental supplies of both feed and feeder cattle. At the same time, proximity to large-volume local markets allows western feedlot operators to adjust more effectively than producers in other areas to preferences of these markets. Furthermore, the Interstate Commerce Commission and the transportation industry have exhibited willingness to adjust rates on westward movements of feed grain and feeder cattle to maintain the competitive situation of the western cattle feeding industry.

Fed cattle produced in the West, however, are virtually committed to western markets. As a result, errors by Far Western feedlot operators in estimating future market requirements lead to sharp adjustments in market prices. Increases in these prices above levels which represent spatial equilibrium immediately induce inshipments of both live and dressed fed beef from eastern Colorado and other Great Plains locations. These rather quickly reestablish spatial equilibrium. Reductions in California market prices below equilibrium levels, however, are not so easily and quickly corrected. The outshipments necessary for adjustment must carve new channels of distribution and often must move across the Nation to the Northeast to find an acceptable market. The Northern and Southern Plains, which have few attractive alternative enterprises, at the same time will probably remain large producers of feeder cattle and fed beef. The West, however, may be a potential market for the Northern and Southern Plains in the decade ahead provided the growth in population and in demand outstrips production in the West. But this will depend on changes in all of the competitive relationships involved.

The study has suggested that the Southern Plains, Colorado, the Central Corn Belt, and the various other regions of the North Central area compete for

the growing fed beef markets of the South. This competition may intensify as U.S. production of fed beef continues to grow and as consumption of this beef rises in the South. Greatest relative increases in fed beef consumption to 1975 probably will occur in the South. But this will depend largely on the rate of economic development in the South. Accordingly, the Nation's fed beef industry has a considerable stake in programs to encourage such development in the South and elsewhere.

In competition with most other surplus regions, the Southern Plains apparently enjoys a locational advantage relative to deficit markets in the South. Much will depend, however, on relocational trends in the fresh beef packing industry, and on adjustments in other factors. Traditionally a raw material supply area, the Southern Plains region has only begun to adjust to its emerging role as a surplus producer of the finished product. If this region is to realize fully the potentials offered by its locational advantages, facilities and conditions must be present for dependable, large-volume, low-cost shipments of dressed fed beef rather than live fed cattle to the South and elsewhere.

Assuming continued increases for the Southern Plains in fed beef production and slaughter, adjustments will be necessary in many other surplus regions. Fed beef shippers in Colorado, the Northern Plains, Kansas, and Missouri, for instance, may find it necessary to market larger quantities in the Middle Atlantic and Northeastern regions. Colorado and other Northern Intermountain States probably would be most severely affected.

The study of interregional competition is in its infancy. Only a few of the many factors affecting interregional competition in fed beef have received any research attention. Many additional analyses, including basic studies in methodology, are needed. Among the factors requiring additional study are shifts in the location of feed grain and feeder cattle production, changes in transportation costs on feed grain, regional differences in quality and price of feeder cattle, regional variations in physical relationships responsible for differences in feeding efficiency, geographic differences in systems of production, differences in feeding rations, economies of feedlot utilization and scale, differences in interregional transportation, costs, and many others.

Much additional work is needed on effects of regional differences in demand for fed beef. Additional research in other areas is also needed. However, progress will be severely limited unless improvements are made in the basic data. For example, little or no reliable regional or State data have been collected on fed beef consumption and slaughter. Only rough estimates of effective transfer costs and transfer cost relationships are available. The potential contributions which studies of interregional competition could make to both public and private policy decisions seem to justify efforts to collect more and better data. Improvements in the availability of necessary data would require a national effort, and the close cooperation of public agencies and of all sectors of the fed beef industry.

APPENDIX I: FED BEEF CONSUMPTION ESTIMATES

Regional consumption of fed beef was estimated by developing equations for fed beef and all beef for 1947-62. Consumption estimates of fed beef were further adjusted through the use of (1) 1955 Household Consumption Survey data

for four broad regions of the United States, (2) estimated income elasticities for specified regions of the South, and (3) a ratio estimating technique involving regional and national incomes and consumption. 34/

Fed Beef Demand Equation

The demand for fed beef is generally postulated as a function of the price of fed beef, the prices of substitute commodities (and complements), the level of consumer income, the number of consumers, and the general price level. The per capita consumption of fed beef (y_1) in this study was specified as a function of the deflated price of fed beef (x_1), the deflated price of nonfed beef (x_2), the deflated price of pork (x_5), and the deflated per capita consumer income (x_6). 35/ However, the correlation coefficient between the deflated prices of fed beef and nonfed beef was .945, indicating a high degree of intercorrelation. To reduce this intercorrelation and at the same time retain the effect of nonfed beef substitution, the ratio of deflated price of fed beef to the deflated price of nonfed beef (x_3) was introduced into the fed beef equation.

Since the price of fed beef was not statistically significant, another equation was estimated in which the price of fed beef was omitted. This equation was as follows: 36/

$$y_1 = -18.9131 \underset{(2.06)*}{- 49.4556x_3} \underset{(.38)}{+ .1053x_5} \underset{(9.16)***}{+ .0763x_6} \qquad (1)$$

$$R^2 = .90 \quad S^2 = 12.77 \quad d' = 1.85 \quad 4\text{-}d' = 2.15$$

Only two variables, price ratio and income, were statistically significant and both had the expected signs. The coefficient for the price of pork (x_5) was not statistically significant even though it had the expected positive sign.

The price ratio would be increased by a rise in the price of fed beef relative to nonfed beef. If the price of fed beef rose with no change in the price of nonfed beef, the relationships would reflect the direct price elasticity of demand. Using the 1960 price of nonfed beef as a base, the price elasticity of demand would be -1.12. If the price of nonfed beef decreased while fed beef prices remain unchanged at the 1960 level, the cross price elasticity of demand would be 1.19.

34/ For additional details of these adjustments see Dietrich, R. A., An Interregional Analysis of the Fed Beef Economy, unpublished Ph. D. dissertation, Okla. State Univ., Aug. 1964.

35/ A limitation of this function is the use of the all meat component of the Consumer Price Index as the deflator for meat prices.

36/ The following format was used in the fed beef and all beef equations. The t-value of the estimated parameter is directly below each coefficient. (*), (**), and (***) denote statistical significance at 10, 5, and 1 percent probability levels, respectively. The coefficient of determination (R^2), the estimated variance (S^2), and the Durbin-Watson statistic (d') are below the equation.

The coefficient for consumer income reflects the importance of increasing income for increasing consumption of fed beef. The income elasticity estimates were 2.92 computed at mean values for the 1947-62 period and 2.37 computed at 1960 levels.

The coefficient for the price of pork was not used directly in estimating fed beef consumption and was inserted into the constant term at its mean value. The coefficient of x_1 was derived in equation (1) by arbitrarily holding the price of nonfed beef constant at the 1960 level. 37/ The fed beef equation adapted for use in developing consumption estimates at the 1960 levels was as follows:

$$y_1 = -14.9588 - .7466x_1 + .0763x_6 \qquad (2)$$

where:

x_1 = the price of fed beef,

x_6 = per capita consumer income.

All Beef Equation

An all beef equation was derived to supplement the estimation of regional fed beef consumption. The all beef equation was as follows:

$$y_2 = -75.1050 - \underset{(2.99)**}{.4663x_4} + \underset{(3.40)***}{.8176x_5} + \underset{(16.27)***}{.0959x_6} \qquad (3)$$

$$R^2 = .96 \quad S^2 = 6.33 \quad d' = 1.70 \quad 4\text{-}d' = 2.30$$

where:

y_2 = per capita consumption of all beef,

x_4 = the deflated retail price of all beef.

The coefficients associated with the price of beef and price of pork were statistically significant at the 5 and 1 percent levels, respectively. The price elasticity of demand for all beef was -.38 at the mean for 1947-62, the same as for 1960.

The income coefficient was significant at the 1 percent level. The income elasticity of demand for all beef was 1.78 at the mean for 1947-62 and 1.73 for 1960, compared with an income elasticity of 1.5 derived by Malone. 38/

37/ The price ratio coefficient, -49.455644, in equation (1) was divided by 66.24, the 1960 price of nonfed beef.

38/ Malone, p. 73 of reference cited in footnote 14, p. 20.

Table 13.--Fresh beef transportation rates, per hundredweight, by regions

Region and city	New York	Richmond	Atlanta	Orlando	Baton Rouge	Nashville	Little Rock	Austin	Oklahoma City	Chicago	Milwaukee	Kansas City	Aberdeen	Butte	Denver	Albuquerque	Phoenix	Salt Lake City	Portland	Fresno
	Dollars																			
1 New York	.90	1.96	2.46	2.92	2.06	2.72	3.44	3.07	1.92	2.08	2.60	3.14	4.21	3.59	3.73	4.27	4.14	5.06	5.09	
2 Richmond		1.31	1.84	2.46	1.51	2.32	3.09	2.84	1.82	1.99	2.39	3.07	4.12	3.45	3.73	4.27	4.14	5.06	5.09	
3 Atlanta			1.19	1.45	0.75	1.30	2.10	1.97	1.65	1.83	1.85	2.89	3.88	2.97	2.98	3.55	3.88	4.69	4.40	
4 Orlando				1.71	1.78	2.11	2.54	2.72	2.58	2.70	2.69	3.54	4.43	3.59	3.26	3.95	4.28	5.27	4.76	
5 Baton Rouge					1.45	1.01	1.14	1.47	2.12	2.25	1.81	3.06	3.77	2.63	2.33	2.99	3.35	4.50	3.99	
6 Nashville						0.97	1.94	1.65	1.15	1.32	1.36	2.43	3.50	2.51	2.67	3.41	3.42	4.33	4.27	
7 Little Rock							1.24	0.95	1.55	1.69	1.06	2.22	3.42	2.15	2.02	2.83	3.05	4.30	3.61	
8 Austin								1.07	2.46	2.59	1.76	2.66	3.57	2.04	1.66	2.22	2.75	4.19	3.31	
9 Oklahoma City									1.84	1.91	0.86	1.91	3.05	1.48	1.36	2.19	2.41	3.84	3.03	
10 Chicago										0.35	1.26	1.66	3.02	2.24	2.76	3.45	2.99	3.94	4.27	
11 Milwaukee											1.36	1.53	2.88	2.22	2.84	3.56	3.05	3.84	4.38	
12 Kansas City												1.45	2.69	1.47	1.82	2.63	2.42	3.63	3.47	
13 Aberdeen													1.81	1.61	2.41	3.13	2.22	3.01	3.73	
14 Butte														1.87	2.29	2.43	1.11	1.50	2.73	
15 Denver															1.10	1.88	1.27	2.74	2.84	
16 Albuquerque																1.16	1.47	2.97	2.10	
17 Phoenix																	1.62	2.72	1.47	
18 Salt Lake City																		1.85	1.95	
19 Portland																			1.94	
20 Fresno																				

Table 14.--Fed cattle transportation rates, per hundredweight, by regions

Region and city	New York	Richmond	Atlanta	Orlando	Baton Rouge	Nashville	Little Rock	Austin	Oklahoma City	Chicago	Milwaukee	Kansas City	Aberdeen	Butte	Denver	Albuquerque	Phoenix	Salt Lake City	Portland	Fresno
	Dollars																			
1 New York	0.62	1.29	1.53	1.87	1.37	1.74	2.23	2.01	1.33	1.42	1.75	2.02	2.69	2.33	2.60	3.06	2.79	3.40	3.66
2 Richmond		0.99	1.19	1.59	1.11	1.46	1.98	1.81	1.29	1.37	1.62	1.97	2.58	2.24	2.43	2.83	2.73	3.39	3.44
3 Atlanta			0.88	0.99	0.65	0.88	1.41	1.33	1.15	1.24	1.31	1.85	2.48	1.94	1.97	2.31	2.45	3.14	2.92
4 Orlando				1.25	1.18	1.37	1.71	1.73	1.63	1.72	1.73	2.30	2.79	2.34	2.11	2.70	2.84	3.42	3.19
5 Baton Rouge					1.06	0.69	0.78	1.00	1.33	1.41	1.20	1.96	2.46	1.68	1.57	1.91	2.17	3.00	2.63
6 Nashville						0.67	1.32	1.12	0.84	0.94	0.96	1.56	2.27	1.66	1.80	2.21	2.30	2.88	2.83
7 Little Rock							0.85	0.65	1.05	1.01	0.91	1.23	2.22	1.24	1.43	1.91	2.02	2.85	2.35
8 Austin								0.73	1.56	1.35	1.13	1.11	2.28	1.24	1.29	1.86	2.08	2.94	2.20
9 Oklahoma City									1.22	1.13	0.73	1.25	2.05	1.16	1.00	1.58	1.67	2.52	2.01
10 Chicago										0.26	0.85	1.11	1.93	1.45	1.76	2.24	1.93	2.58	2.83
11 Milwaukee											0.94	1.04	1.86	1.54	1.84	2.32	2.02	2.52	2.91
12 Kansas City												0.99	1.71	1.00	1.31	1.80	1.63	2.37	2.29
13 Aberdeen													1.24	1.13	2.06	2.54	1.50	1.93	2.56
14 Butte														1.32	1.68	1.76	0.83	1.14	1.73
15 Denver															0.77	1.50	0.98	1.80	1.88
16 Albuquerque																0.83	1.10	2.25	1.42
17 Phoenix																	1.37	2.03	1.12
18 Salt Lake City																		1.31	1.31
19 Portland																			1.35
20 Fresno																			

Table 15.--Per capita fed beef consumption, per capita income, and population, by regions, United States, 1960

Regions	Per capita fed beef consumption 1/	Per capita income 2/	Population
	Pounds	Dollars	Thousands
(1) Northeast	53.0	1,748	49,096
(2) Va., W. Va., N.C.	27.3	1,191	10,405
(3) Ala., Ga., S.C.	21.9	1,061	9,627
(4) Florida	36.7	1,385	5,005
(5) Miss., La.	20.2	1,020	5,443
(6) Ky., Tenn.	23.2	1,083	6,613
(7) Arkansas	18.1	961	1,789
(8) Texas	36.0	1,346	9,643
(9) Oklahoma	33.3	1,285	2,340
(10) Ohio, Ill., Ind., Iowa	52.0	1,655	27,252
(11) Mich., Minn., Wis.	46.8	1,531	15,232
(12) Kans., Mo.	45.7	1,506	6,501
(13) Nebr.,N. Dak., S. Dak.	40.9	1,389	2,740
(14) Mont., Idaho, Wyo.	49.3	1,365	1,686
(15) Colorado	54.1	1,573	1,769
(16) New Mexico	42.6	1,266	958
(17) Arizona	49.8	1,398	1,326
(18) Utah, Nevada	54.6	1,473	1,193
(19) Washington, Oregon	59.2	1,560	4,649
(20) California	73.8	1,881	15,845
U.S.	46.5	1,534	179,112

1/ These are equilibrium consumption estimates representing actual 1960 consumption patterns.
2/ Deflated by the Consumer Price Index, 1947-49 = 100.

Table 16.--Estimates of labor volume cost differentials, by regions, 1960

Region	Unadjusted labor costs due to output 1/	Final adjusted volume-wage costs 2/	Volume-wage cost differentials 3/
(1)	(2)	(3)	(4)
	Dollars		
1	0.867	0.731	0.070
2	.926	.424	-.237
3	1.093	.694	.033
4	1.017	.584	-.077
5	1.065	.661	.000
6	.987	.784	.123
7	1.098	.619	-.042
8	.936	.680	.019
9	1.043	.836	.175
10	.687	.638	-.023
11	.679	.701	.040
12	.712	.632	-.029
13	.706	.661	.000
14	.868	.687	.026
15	.710	.652	-.009
16	.990	.646	-.015
17	.930	.765	.104
18	.875	.795	.134
19	.870	.784	.123
20	.771	.771	.110

1/ Slaughter volume costs are based on output costs from a study by Logan and King in California. Costs in column 2 have not been adjusted for regional differences in wages.

2/ Slaughter volume costs adjusted for regional differences in wages.

3/ Regional differences in volume-wage costs (column 3) relative to Region 13.

Table 17.--Example of the tableau for obtaining an optimum simultaneous distribution for live fed cattle and dressed fed beef 1/

Region 3/		P_0	2/P_1 8B 1B	P_2 8B 2B	P_3 8B 5B	P_4 8B 19B	P_5 10A 1A	P_6 10A 2A	P_7 10A 8A	P_8 10A 19A	P_9 10B 1B	P_{10} 10B 2B	P_{11} 10B 5B	P_{12} 10B 19B	P_{1n}---	P_{in}
Surplus																
8B	4/	xxx	1.0	1.0	1.0	1.0										
10A		xxx					1.0	1.0	1.0	1.0						
10B		xxx									1.0	1.0	1.0	1.0		
Deficit																
1A		xxx	1.0				1.0				1.0					
2A		xxx		1.0								1.0				
5A		xxx			1.0			1.0					1.0			
8A		xxx							1.0							
19A		xxx				1.0				1.0				1.0		
Unused Slaughter Capacity																
1B		xxx	1.0								1.0					
2B		xxx		1.0								1.0				
5B		xxx			1.0								1.0			
	5/		C_{ij}	C_{ij}	C_{ij}	C_{ij}	C_{ij}	C_{ij}	C_{ij}	C_{ij}	C_{ij}	C_{ij}	C_{ij}	C_{ij}	C_{ij}	C_{ij}

1/This tableau represents only a small portion of the tableau actually employed. This example is intended to demonstrate the various situations that existed for this type model.

2/P_1 or $\frac{8B}{1B}$ represents possible shipments of live fed cattle from Region 8 to Region 1, etc.

3/"B" represents supply and demand for live fed cattle (dressed equivalent) and "A" represents supply and demand for dressed fed beef.

4/The X's represent the surplus and deficit volumes which were used in the model.

5/The C_{ij}'s represent transportation costs for shipping live fed cattle or dressed fed beef among the various regions. A penalty price of $10 was assessed to all surplus fed beef production areas and to all deficit dressed fed beef regions to assure distribution of total surpluses and deficits. Penalty prices were not assessed for unused slaughter capacity.

Table 18.--Model IV: Optimum shipments, opportunity costs, and price differentials for fed beef, 1960, with assumed increases in production and slaughter for the Southern Plains

Shipping region	Destination 1/											Total shipments	Price differentials 2/
	1	2	3	4	5	6	7	16	17	19	20		
8	0.94	0.69	0.24	36,287	61,906	0.57	0.40	1.61	1.39	3.63	1.52	98,193	0.64
9	.46	.33	137	.07	.22	.17	17,461	1.20	1.25	3.17	1.13	17,598	.53
10	802,473	26,783	.37	.62	1.56	.36	1.29	3.29	3.20	3.96	3.06	829,256	1.22
11	234,350	.01	.39	.58	1.53	.37	1.27	3.21	3.15	3.70	3.01	234,350	1.06
12	.11	48,460	127,095	.16	.68	68,573	.23	1.78	1.81	3.08	1.69	244,128	.65
13	886,945	.03	.39	.36	1.28	.42	.74	1.72	1.66	1.81	1.30	886,945	0
14	.77	.78	1.08	.95	1.69	1.19	1.64	1.30	.66	391	37,176	37,567	-.30
15	.04	154,535	.06	92,732	.44	.09	.26	19,180	2,002	1.13	39,545	307,994	-.41
18	1.48	1.58	1.86	1.58	2.05	1.89	2.05	1.26	.63	1.13	23,055	23,055	.48
Total	1,923,768	229,778	127,232	129,019	61,906	68,573	17,461	19,180	2,002	391	99,776	2,679,086	---
Price differentials	3.14	3.04	2.50	3.18	1.78	2.01	1.48	.69	1.47	1.20	2.43	---	---

Total shipments (1,000 pounds) = 2,679,086; total transport costs = $66,360,099; equilibrium price (Region 13) = $72.31.

1/ Underlined numbers are shipments (in thousand pounds). Other numbers are opportunity costs which result from not having an activity in the optimum solution. These costs are shown in dollars per hundredweight.

2/ Price differentials are differences in regional prices relative to the base region (Region 13).

Table 19.--Model V: Optimum shipments, opportunity costs, and price differentials for fed beef, 1960, with assumed increases in production and slaughter for the Southern Plains, Colorado, Kansas, and New Mexico

Shipping region	Destination and quantities received											Total shipments	Price differentials 3/
	1	2	3	4	5	6	7	16	17	19	20		
8	.90 1/	.69	.24	16,728	68,325	.57	.17	1.61	1.39	3.63	1.52	85,053	.60
9	.65	.56	.23	.30	.45	.40	14,946	1.43	1.48	3.40	1.36	14,946	.72
10	787,441 2/	.04	.41	.66	1.60	.40	1.10	3.33	3.24	4.00	3.10	787,441	1.22
11	211,394	.05	.43	.62	1.57	.41	1.08	3.25	3.19	3.74	3.05	211,394	1.06
12	.07	153,639	139,212	.16	.68	76,147	4,219	1.78	1.81	3.08	1.69	373,217	.61
13	883,294	.07	.43	.40	1.32	.46	.55	1.76	1.70	1.85	1.34	883,294	0
14	.73	.78	1.08	.95	1.69	1.19	1.41	1.30	.66	8,089	26,836	34,925	-.34
15	121,378	90,088	.06	119,035	.44	.09	.03	11,548	4,062	1.13	81,084	427,195	-.45
18	1.44	1.58	1.86	1.58	2.05	1.89	1.82	1.26	.63	1.13	21,136	21,136	.44
Total	2,003,507	243,727	139,212	135,763	68,325	76,147	19,165	11,548	4,062	8,089	129,056	2,838,601	
Price differentials	3.14	3.00	2.46	3.14	1.74	1.97	1.67	.65	1.43	1.16	2.39		

Total shipments (1,000 pounds) = 2,838,601; total transport costs = $71,435,950; equilibrium price (Region 13) = $72.32.

1/ These are opportunity costs which result from not having an activity in the optimum solution. These costs are shown in dollars per hundredweight.
2/ Shipments are in thousand pounds.
3/ Price differentials are differences in regional prices relative to the base region (Region 13).

Table 20.--Model VI: Optimum shipments, opportunity costs, and price differentials for fed beef, 1960, with assumed increases in production and slaughter for the Southern Plains, Colorado, Kansas, New Mexico, and other Southern regions

Shipping region	Destination and quantities received											Total shipments	Price differentials 3/
	1	2	3	4	5	6	7	16	17	19	20		
8	.90 1/	.76	.31	8,654	66,617	.64	.47	1.61	1.39	3.63	1.52	75,271	.60
9	.35	.33	0	989	.15	.17	11,021	1.13	1.18	3.10	1.06	12,010	.42
10	755,669 2/	.11	.48	.66	1.60	.47	1.40	3.33	3.24	4.00	3.10	755,669	1.22
11	195,392	.12	.50	.62	1.57	.48	1.38	3.25	3.19	3.74	3.05	195,392	1.06
12	10,078	232,577	63,001	.09	.61	58,697	.23	1.71	1.74	3.01	1.62	364,353	.54
13	880,297	.14	.50	.40	1.32	.53	.85	1.76	1.70	1.85	1.34	880,297	0
14	.73	.85	1.15	.95	1.69	1.26	1.71	1.30	.66	13,746	19,315	33,061	-.34
15	217,354	.07	.13	78,138	.44	.16	.63	12,549	5,518	1.13	111,582	425,141	-.45
18	1.44	1.65	1.93	1.58	2.05	1.96	2.12	1.26	.63	1.13	19,752	19,752	.44
Total	2,058,790	232,577	63,001	87,781	66,617	58,697	11,021	12,549	5,518	13,746	150,649	2,760,946	---
Price differentials	3.14	2.93	2.39	3.14	1.74	1.90	1.37	.65	1.43	1.16	2 39	---	---

Total shipments (1,000 pounds) = 2,760,946; total transport costs = $70,247,120; equilibrium price (Region 13) = $72.34

1/ These are opportunity costs which result from not having an activity in the optimum solution. These costs are shown in dollars per hundredweight.

2/ Shipments are in thousand pounds.

3/ Price differentials are differences in regional prices relative to the base region (Region 13).

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